THE

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THE

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1900

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NOW IN PREPARATION.

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THE BOARD OF TRADE AND ELECTRIC TRAMWAYS.

THE report of Mr. A. P. Trotter, Inspector of the Board of Trade, on the series of accidents on the Dublin tramways, has just been issued, and it contains some interesting, if not curious, conclusions. The report deals with four accidents, each of which was due to the rising of the trolley head above its ordinary position. In the first two accidents, the trolley head tore down the overhead wires, the third resulted in a trolley pole being broken, and in the last accident a detachable trolley head came off. Although these accidents are somewhat trivial in their nature, it is obvious that one or more of them might result in loss of life, and, in the interests of the public, as well as of electric tramway undertakings, there would be wisdom in adopting precautions which should tend to prevent a recurrence. It can hardly be doubted that all overhead equipment, as well as the trolley pole, is peculiarly liable to mishaps, similar to the ones under review; indeed, there are few electric tramway systems in this country which have not, at some time or other, experienced considerable annoyance from the trolley jumping a wire. One cannot help recognising the improvements that have been made in the various parts of the trolley pole, but it is clear that we have not yet arrived within a measurable distance of perfection. It may be taken for granted that, at some time or other, the trolley pole will jump the wire, and one has to seriously consider how the trolley head may be prevented from working mischief as soon as this happens. Unfortunately, the overhead wire system is handicapped by the necessity of using guard wires, and there are many instances on record where these have been completely torn down by the trolley pole. Mr. Trotter's report carefully reviews the standard practice in trolley work, and he clearly points out some of the troubles that may arise in the methods now in vogue. He states that where the Dickinson system is used to a moderate extent, the trolley wire being nowhere more than 5 or 6 feet from the perpendicular to the centre of the track, a trolley rope may be employed in the ordinary way, but it would be better to secure it to the foot of the trolley pole by a hook and ring. This, unfortunately, would remove the trolley rope entirely out of the immediate control of the conductor, and if, as happened in Dublin, a passenger were ignorant enough to mistake the trolley rope for a bell rope, he might just as easily interfere with the rope (which would be within his reach), if the suggestion of Mr. Trotter were carried out. One of the most serious troubles that is likely to arise from trolleys jumping the line, although the matter is not seriously dwelt upon by Mr. Trotter, is in the case of tramways using a span-wire system, for it is obviously easier, in the case of the trolley leaving the overhead wire, for it to catch in the cross wire than in the conductor itself. It is quite true that trolley heads have been devised which, to some extent, minimise troubles of this nature; but it is doubtful as to the extent to which they may prevent a

recurrence of accidents, similar to those of Dublin. There is one point, however, which Mr. Trotter brings forward, which is deserving of the very greatest consideration. He points out that the centre pole arrangement, with brackets on each side for carrying the trolley wire, is used to a limited extent in Dublin, and is said to be unsuitable, on account of the unsystematic driving of cars, wagons, &c.; but it is difficult to see that even an Irishman's idea of unsystematic driving would be such as to cause him to collide with centre poles; nor do we think that an Irish jaunting car would gain much advantage by colliding with a heavy tramway pole. We emphasise this portion of the report because it is said that some of the brackets used in Dublin are of great length, several extending 20 feet. After a careful survey of most of the tramway systems in this country, we are inclined to the opinion that long-arm brackets are distinctly unsightly, and the wonder is, that local authorities have not, when raising objections to overhead wire systems, pointed out this somewhat aggressive feature of overhead equipment. Besides, we do not think that these long-arm brackets are altogether necessary, and we certainly are of opinion that they may do electric tramway practice a good deal of harm. We admit, without reservation, the difficulties that are met with in overhead wire construction, and although at times it may be necessary to adopt long-arm brackets, yet we are familiar with many instances where some other method might have been adopted with great advantage. At the present stage of electric tramways practice, it would be most unfortunate if the public were to become dissatisfied with the way in which systems are laid out; it is important to adopt those methods which give the maximum of safety and are compatible with neatness of design, and it can hardly be denied that long-arm brackets are being somewhat overdone. An almost cynical reference is made to the electric shocks that might be experienced on tramways, and Mr. Trotter observes that an electric pressure of 500 volts has been chosen because the result of shocks, due to light or brief contact, is not serious. The employés often receive them, but generally from carelessness. We are inclined to think that this is hardly the right view to take of the question, because, though 500 volts is generally safe, no efforts should be relaxed to make it impossible that the public should come in contact with the wire, for, after all, it is possible to kill even with 500 volts, and that possibility should never be lost sight of. It is unnecessary to labour this point further, but even if 500 volts were not sufficient to kill a person, it might effect very serious injury; and it is not so much the passenger on an electric tramway who runs the greatest danger, but the man in the street who comes in proximity to a fallen wire. The recommendations put forward by Mr. Trotter are little more than mild suggestions. He looks upon guard wires as a necessary evil, and suggests that they should be so well connected to earth by connecting the poles to the rails that any serious rush of current would melt the fuses in the feeder boxes. It might be desirable to add to the present tramway equipments such a fuse, though we are afraid that many tramway authorities would seriously object to it. One of the most important remarks, however, is on the form of guard wires. Apparently Mr. Trotter is not prepared to recommend wooden strips in the place of guard wires, and after seeing those in operation at Liverpool, one is inclined to think that they not only make the overhead line appear heavy and cumbersome, but they would not prevent a fallen wire twisting round the live conductor and thus becoming charged with a current of electricity. The adoption of a system of guard wires carried on the telegraph or telephone wires, is, however, in common use on the Continent, but, after all, is there any system of guard wires which would absolutely prevent a telephone or telegraph wire coming into contact with the live portion of a tramway system? We are afraid not. But what would be a distinct improvement is the practice commonly adopted on the Continent of the telegraph and telephone wires being compelled to cross the electric tramway at certain specified points. That, of course, would not get over the difficulty of telegraph wires running alongside the tramway; indeed, we do not know of any guard which would prevent a wire being blown sideways on to a trolley wire. The proposals, however, of Mr. Trotter are not likely to cause any hardship to tramway companies; indeed, they are exceedingly moderate, and we are sure that no owners of tramways would object to carrying them into effect if there is any probability of their ensuring a greater safety of the public.

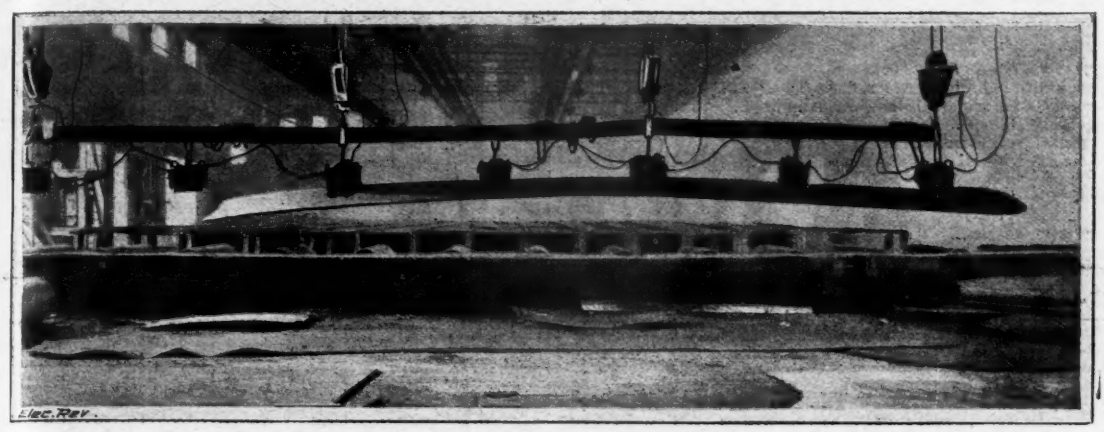
Physical Society Meeting.

Mr. F. S. Spiers, in a paper read last Friday at the Physical Society, describes his attempts to obtain positive evidence as to the effect of the enveloping medium upon the contact potential differences of two metals, and thus to settle once for all the cardinal question in dispute between controversialists with regard to the seat of electromotive force in a voltaic cell. Our readers may remember that the experiments of Pfaff and Pellat, upon contact potential differences of pairs of metals in various gases, led to the assumption that, so long as there is no visible chemical action, the effect is almost independent of the gaseous envelope; and that Hankel pointed out that the potential difference of the two metals in contact is in some measure affected by the condition of the surface. More recently, Brown has shown that while, in air, copper is negative to iron, it is positive to iron in a medium of sulphuretted hydrogen. But as none of these experimenters took precautions to remove the air-films from the metals, there is in all cases doubt as to the exact nature of the enveloping medium. With great perseverance Mr. Spiers has tried to get rid of the air-films by replacing the air by hydrogen, in a heated glass tube, afterwards exhausting the hydrogen. The primary object being to remove the air-film, this may be an improvement on the method adopted by Bottomley, who enveloped the metals in melted wax; but it appears to be rather more than likely that in attaining his primary object, Mr. Spiers has introduced secondary actions of sufficient importance to vitiate the results. We notice that he is dealing with differences as small as $\frac{1}{500}$th of a volt, measured by a compensation potentiometer after the manner of Pellat and Kelvin. There can be little doubt as to the accuracy of the measurements, but there does appear to be reason to hesitate before accepting the author's interpretation of the observed potentials. In his experiments there are many conditions that might account for a stray $\frac{1}{100}$th of a volt. The electrification of the glass tube is one of them, the thermal differences are another, and there may even be an actinic effect. We fully appreciate the difficulties of his experiments, and we have nothing but praise for his brave attempt to carry them through; it is to be hoped, however, that when the investigation reaches its final shape, identical, or nearly identical, readings will be obtained from a second, third, fourth, and perhaps a fifth apparatus. The discussion did not amount to much. Dr. Armstrong had probably in view the experiments of Brereton Baker, who showed that moisture is essential to the combustion of phosphorus, sulphur, and similar substances in oxygen; he suggested, therefore, that since it was almost impossible to remove the oxygen film, it might be worth while to try to remove the moisture, and so prevent oxidation. Dr. Lodge maintained complete control of his powers of argument, and while making it perfectly clear, in a few words, that he surrendered nothing of his old views on contact electricity, he suppressed his controversial instincts with complete success. Indeed, we never remember an occasion of the kind where one who could say so much, did say so little.

ELECTRICAL POWER IN STEEL WORKS.

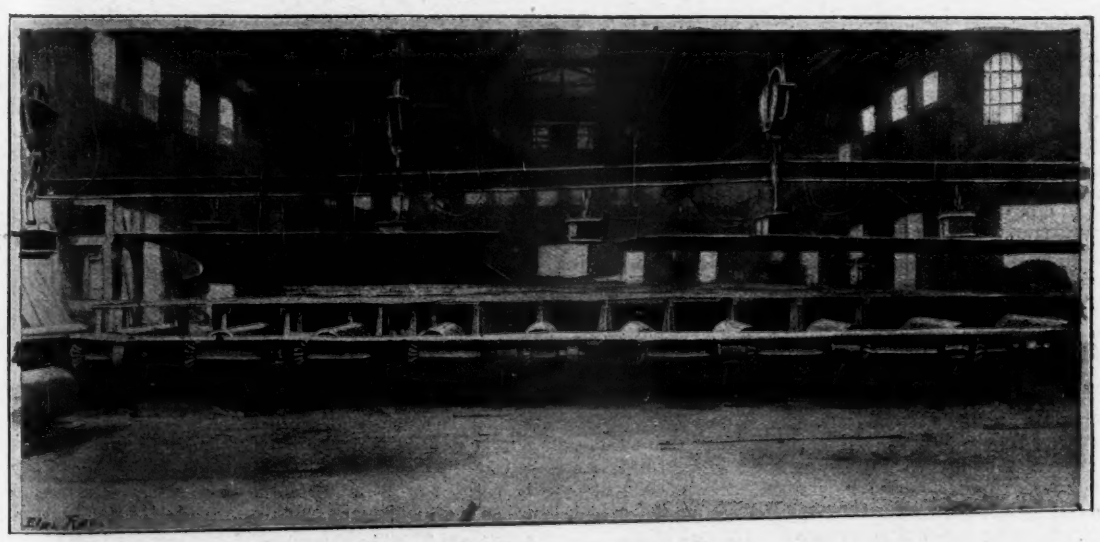
The illustrations herewith reproduced from the *American Electrician*, show electro-magnetic cranes carrying plates from the rolls to the shears, and carrying a long plate, also, in the works of the Illinois Steel Company, who have made very extended use of electric power for all the purposes of steel manufacture. The Illinois Steel Company's works covers an area of 450 acres in South Chicago. In the open hearth steel department, motors of 1,200 aggregate horse-power are employed, and motors of the same capacity in the slab mill. Their use is not confined to cranes, but they are used to work charging cars, to lift ingots, to drive transfer tables, &c. In the open hearth department are cranes of 75-ton capacity each, employed to handle ladles. The large cranes each carry two travelling hoists, one of which is of 20-ton capacity for turning ladles to empty them of slag. There are seven motors on the large cranes, another of which is to be installed, while there are two 30-tons and a 40-tons crane in the same department. In the new crane, steel wire ropes will be used in place of chains.

The charging cars referred to are employed to place metal in the furnaces. They run on a very wide gauge track and carry a long arm, which can tilt up and down, and turn half over, as well as advance and retreat. All these movements are controlled from a distance by one operator. The metal to be loaded is cut up and placed in suitable pans of cast-iron. These are placed on racks along the face of the furnaces. The ram picks up the boxes by a special dovetail locking recess. It moves to the furnace front, the ram is extended, the box inverted, and its contents dumped upon the molten mass inside the furnace, all without excessive exposure of the operatives to heat. While so much used for plate lifting and carrying, electro-magnets here find a limit set on their powers. They cannot lift hot plates without injury to their insulation.



Electro-magnets Carrying One Long Plate.

The central generating plant includes two 400-kw. Westinghouse generators, coupled direct to tandem compound Porter-Allen engines. The current is direct, at 250 volts.



Testing an Electro-magnet: Weight, 120 lbs.; Load, 3,000 lbs.; Current, 2½ amperes at 110 volts.

There is also a 600-H.P. vertical McIntosh & Seymour engine direct coupled to a 300-kw. Westinghouse generator.

The arc light plant consists of six T.H. machines, driven in pairs by three 100-H.P. Westinghouse motors, and there is also a 60-kw. alternator for incandescent lights. About 50 per cent. is saved in power cost by the electrical system over the steam power formerly employed.

COST OF CENTRAL STATION PLANT.

Now that electric lighting is settling down into a steady business, one can predict with a fair amount of accuracy the lines on which the electric lighting of a given sized town will move. It is, therefore, possible to arrange the size of the station and the output of the initial generating sets so

D

Approximate Cost of Various

Population of town, say	20,000	30,000	45,000
8-c.p. lamps fixed	4,500	6,000	9,000
8-c.p. lamps alight at one time	3,000	4,000	6,000
Kilowatts of plant required (without spare)	90	120	180
Total kilowatts of plant installed...	135	180	270
Buildings, engine and boiler houses, accumulator and test rooms, workshops, offices, &c.	£2,200	£2,700	£3,000
Chimney with lightning arrester, flues, &c.	550	650	650
Foundations for engines, boilers, &c., no piling...	270	300	350
Weighbridge, 3 tons...	35	35	35
Overhead traveller and rails, hand power	5 tons, 25 ft. span, 130	6 tons, 30 ft. span, 160	6 tons 30 ft. span 160
Two boilers, with injectors and fittings	1,660	1,950	2,300
Economiser, with motor	220	260	260
Steam, exhaust, drain and feed pipes, valves, hangers, chequer plating water meter, &c.	800	900	1,000
Water storage tank	60	60	60
Pumps, one steam and one electric, for boiler feed, and an electric centrifugal pump for filling tank.	280	320	320
Feed water heater	120	120	150
Three engines of the high speed enclosed type	45 kw. each	60 kw. each	90 kw. each
Three dynamos	550 revs. 2,060	500 revs. 2,500	450 revs. 3,290
Balancing machine (two armatures) with sp. arm., field coil, &c. ...	200	250	360
Booster (one motor two dynamos) with sp. arms., field coils, &c. ...	170	210	280
Main switchboard, works switchboard, meters, resistances, and connecting cables	500	650	850
Testing instruments...	80	105	135
Accumulators with glass boxes, acid, stands, cell testers, hydrometers, &c.	550	700	850
Workshop tools, barrows, pipe spanners, oil filter and tank, &c. ...	45	50	60
Station and office lighting	70	80	90
Total cost	£10,000	£12,000	£14,200
Cost per kw. of plant installed	£74	£65·75	£52·5

that they are in proportion to the units that will be required later on. It is almost as great a mistake to start with 60 kw. sets for a town of, say, 150,000 inhabitants, as it would be to lay down a 300-kw. steam dynamo for lighting a village.

In the accompanying table the writer has indicated what he considers should be the sizes of the initial plant for towns of various populations, and has filled in under each one figures indicating approximately the cost of the various items which go to make up a complete central station plant. In order to have some basis to work on the following assumptions have been made:—

(*a*) The system of distribution to be by continuous current on the three-wire system with 440 volts across the outers.

(*b*) The number of lamps on the second line is taken as the probable lamp connection before, say, the end of two years, and it is further assumed that about two-thirds of this number will be alight at one time.

(*c*) The kilowatts of plant in use, given in the fourth line, are arrived at by multiplying the numbers in the third line by the watts required per 8 c.p. lamp.

(*d*) It is proposed that three generating units be laid down, one being regarded as a spare.

(*e*) The buildings are assumed to be large enough to hold plant of a capacity equal to three times the estimated number of lamps connected, as given on the second line.

Buildings.—This item of buildings is one which may vary within exceedingly wide limits, according to the amount of ornamentation and finish introduced into the architect's plans. A plain substantial building with stone facings and a height to eaves of about 35 feet should not cost more than about 5½d. per cubic foot. Walsall was about 3d., Bedford 3½d., St. Mary, Newington Vestry, 5d. The iron roofing to the engine and boiler houses accounts for about 10 per cent. of the total cost. An iron building with offices, &c., suitable for central station work runs out at a little over 1d. per cubic foot.

Chimney and Flues.—The cost of the chimney depends to a considerable extent on the nature of subsoil, the usual amount of excavation required to reach a good foundation being 15 feet. The sizes of chimneys vary only very slightly, 140 feet high, with square base and round shaft, 7 feet inside diameter, lined one-third of the way up with firebrick, is the favourite size for stations such as we are now considering, and a chimney such as this would cost about £650. The exhaust to atmosphere should be taken right up the centre and carried to, say, within 20 feet of the top. The work of erecting this pipe is generally undertaken by the contractor for the chimney, but the cost is included in the "steam and exhaust piping" item, which is given on the thirteenth line in the table.

Steel chimneys are quite common in the States, and are likely to come into use over here. They have an elegant appearance, a chimney 125 feet high being only 5 feet diameter, whilst its weight would be 11 tons, and price about £200. It is, of course, lined with firebrick right to the top, but can be erected in one month against five months for an ordinary brick chimney of similar capacity.

Cost of Foundations.—The cost of foundations for engines, boilers, &c., is a very elastic item. If a good deal of piling is required, as happened at Stafford, for example, where the station is situated on a bed of peat, many months of work are required before any concrete can be put in.

Continuous current low pressure stations must of necessity be situated in the midst of the populated area, or near places of business which are liable to be affected by vibration; a great deal of care has therefore to be taken in setting out the engine foundations. The concrete block is generally in one piece, cut off entirely from the walls, and the usual depth is 7 feet with a bottom floor of, say, 9 inches. The engine room floor may be further cut off from the walls by leaving a space of, say, ¾ inch all round.

(To be continued.)

KASHMIR ELECTRIC RAILWAY.

The proposal to connect Kashmir with the Punjab by a light railway worked by electricity brings prominently to the front the question as to how far it is wise to substitute electricity for steam on a railway of such importance.

An article in a recent number of *Indian Engineering* discusses this question in a manner which shows that the writer certainly does not hold a brief for electrical traction. To those who are even fairly acquainted with what has already

Items of Central Station Plant.

60,000 12,000 8,000 240 360	80,000 16,000 10,500 320 480	100,000 20,000 13,000 400 600	125,000 25,000 16,500 500 750	160,000 30,000 20,000 600 900	Column showing the percentage of the various items to the total cost. Approx.	Average cost of the various items per kw. of plant installed.
£3,500	£4,000	£4,500	£5,000	£5,600	2 %	£9·72
750	750	850	850	1,000	4½%	2·1
400	450	500	570	650	2½%	1·1
35	40	40	40	40	¼%	·1
7 tons 35 ft. span 200	7 tons, 35 ft. span 200	8 tons, 40 ft. span 240	8 tons, 40 ft. span 240	10 tons 45 ft. span 290	1 %	·55
2,600	2,950	3,230	3,600	4,000	15 %	7·25
330	360	400	450	500	2 %	·91
1,100	1,200	1,320	1,450	1,650	7 %	3·05
80	80	90	100	100	½%	·22
350	350	400	450	500	2 %	·97
150	170	180	200	210	1 %	·41
120 kw. each	160 kw. each	200 kw. each	250 kw. each	300 kw. each		
400 revs 4,250	350 revs. 5,360	300 revs. 6,350	275 revs. 7,570	250 revs. 8,750	25 %	11·8
470	£600	700	850	1,000	3 %	1·3
350	450	560	640	810	2½%	·97
1,000	1,200	1,400	1,550	1,750	6 %	2·8
165	190	215	240	270	1 %	·46
1,000	1,150	1,300	1,450	1,600	6 %	2·8
70	80	85	90	100	½%	·21
100	120	140	160	180	¾%	·28
£16,900	£19,700	£22,500	£25,500	£29,000	100 %	£47·00
£47	£41	£37·5	£34	£32·2		

been done in this field, the well-worn phrase that "the science is yet in its infancy" sounds a little out of date, and the assertion that "the practice of electrical experts in Europe and America differs in many respects," suggests the thought that precisely the same statement might be made about steam railroad engineering. Again, while it is quite true that the length of the proposed line far exceeds that of any other electric railway hitherto attempted, it is not right to infer that the difficulties to be met with on account of the length are vague and unknown, since they will be of the same order as difficulties that have been already encountered and successfully grappled with on shorter lines. To those who are unacquainted with the technicalities of electrical engineering, it may appear presumptuous to say that the conditions of operating a new line of such a length can be foreseen and provided for with certainty and accuracy; but such is the case, and it is this that constitutes one of the surest guarantees of the future progress of the science of electric railway engineering.

It would, of course, be a mistake to forget that a line nearly 200 miles long must be constructed in a way that will ensure satisfactory working, without the close supervision given to electric roads in cities and towns; but at the same time we must not ignore the fact that much of the vigilance required to operate a city or a suburban line is due to conditions which are absent in such a line as we are now considering. For instance, it is mainly the exigencies of street traffic, and the difficulties of crossings, that oblige us to use an overhead conducting system; but these conditions are absent in the proposed Kashmir Railway, and there is nothing to prevent the use of auxiliary rails, except perhaps in the section between Islamabad and Srinagar; but here the track would be practically level, and there would be no risk of accidents from landslips, falling rocks, or avalanches.

The cost of construction will depend materially upon the ruling gradient and the curve adopted, and the influence of electrical traction on these two factors in the problem is a matter of great importance. The statement in *Indian Engineering* that it is claimed that electrical motors can haul heavier loads and mount steeper grades than steam locomotives requires some modification. The ability of a locomotive to haul a load behind it is limited by the adhesion of the driving wheels on the rails. So long as only a part of the weight of steam locomotives was on the drivers, it might have been said that electric locomotives, with motors on each wheel, could haul heavier loads. On mountain railways, the use of bogie stock has become almost a necessity, and it has been a great problem for steam railroad engineers to apply driving power to every wheel of a locomotive of this type. The problem has, however, been successfully solved, in spite of the difficulties due to the inflexibility of the system, and it may be questioned if any electric locomotive of equal weight will ever be constructed having greater hauling ability than, for instance, one of Mallet's articulated compound locomotives, with double bogies, each carrying two or three coupled axles and a pair of outside cylinders. But the application of this principle is limited to the locomotive, and it is here that the superior flexibility of the electric system comes in by enabling us to place motors on the axles of the carriages or trucks without in any way detracting from their value as traffic carriers, so that, if it were necessary, every wheel in the train could be made a driving wheel. Therefore, while it is not the case that an electric locomotive can haul a heavier load than a steam locomotive of equal weight, we may say that the electric system can deal with heavier loads and grades than the steam system can.

There seems no room to doubt that electrically-driven trains can be run with safety on lines having abnormally sharp curves. Electric railways have been constructed, and are now running satisfactorily with sharper curves than would be considered possible on steam railways, and for this cause one might reasonably look for a marked reduction in the cost of construction.

The question is raised in *Indian Engineering* whether electric motors can be adapted to such small gauges as might be required on a mountain railway. There is abundant evidence on the Continent and in this country to show that the electric motor is perfectly well adapted to small gauges. At the same time, the consideration of efficiency in working would point to the selection of as wide a gauge as possible, and it may be doubted whether it would be wise to make it less than a metre. This conclusion is strengthened by the fact that a wide gauge renders easier the task of placing motors on the axles of the cars, while a very narrow gauge might necessitate the use of locomotives only, and the consequent loss of one of the most valuable features of the electric system.

While discussing the probability of the proposed railway

proving remunerative, *Indian Engineering* curiously omits to consider the saving that would be effected by the use of water-power. There is frequently a tendency on the part of the advocates of electrical traction to over-estimate this saving; but it is going rather too far in the other direction to ignore it altogether.

The fuel item, in many cases, constitutes but a small proportion of the total expenses of working a railway, and the saving due to the use of water-power may consequently be a matter of minor importance. In the case of the Kashmir Railway, however, the high price that would have to be paid for coal makes this question one of considerable magnitude.

Some interesting statistics bearing on this point may be found in the Administration Report on the Railways in India for 1898-99. The figures there given for the North-Western State Railways, which include the short line already constructed to Jammu, from whence the proposed electric railway is to start, show that the total working expenses per train-mile are set down at Rs. 1·95, made up as follows:—Maintenance of way, works, and stations, Rs. 0·58; locomotive expenses, Rs. 0·74; carriage and wagon, Rs. 0·15; traffic, Rs. 0·29; general and miscellaneous, Rs. 0·19. Of the Rs. 0·74 for locomotive expenses, as much as 4·57 Annas is spent on fuel, or 14·6 per cent. of the total working expenses. In this case the cost of coal averages 12·50 rupees per ton.

Now, in the proposed railway to Srinagar, it is estimated that coal would cost from Rs. 20 to Rs. 25 per ton, so that the fuel item would amount to between 22 and 26 per cent. of the total working expenses, taking these on the same basis as on the North-Western system. There is, however, reason to suppose that narrow gauge locomotives working on such extreme variations in grade as on the Kashmir line would not have the efficiency of the normal gauge locomotives on the North-Western system, so that the fuel item might mount up to as much as 30 per cent. of the total working expenses. It is clear, therefore, that the saving to be effected by the use of water-power is considerable, and has an important bearing on the financial prospects of the undertaking.

THE LEGAL RELATIONSHIP OF ELECTRIC LIGHTING OR POWER CORPORATIONS AND MUNICIPAL AUTHORITIES.

The recent resolution of the Municipal Corporations Association to promulgate the establishment and working of electric installations under the auspices of the various local authorities throughout the country, naturally directs our attention to the powers under which such bodies may acquire the right to thus engage in commercial enterprise. It is not our purpose to discuss the expediency of the transfer of such undertakings from private companies to those of a municipal nature, but it is important for all of those who are connected with the supply of electricity, whether for the purposes of lighting or the transmission of power, not only to realise that they may at some time be ousted by a local authority, but to understand the conditions under which the local authority may exercise its power.

By the Electric Lighting Act of 1882, Section 3, the Board of Trade was empowered to license any local authority as defined by the Act, or any company or person, to supply electricity . . . . for any public or private purposes within any area, subject to certain provisions contained in the Act. This would seem to include power and lighting installations.

Local Authority—What Is.

The definition of the term local authority, for the purposes of the Electric Lighting Act of 1882, is contained in Section 31 and the first schedule to the Act. In the City of London the mayor, commonalty and citizens, acting by the Commissioners of Sewers, exercise the powers of the local authority. In those parts of the metropolis which the Metropolitan Board of Works was formerly authorised to light they acted as local authority, but, of course, their duties, &c., are now in the hands of the London County Council. Other "local authorities" of the metropolis are the "Vestries" mentioned in Schedule A, and the "district boards" enumerated in Schedule B of the Metropolis Management Act, 1855, which has been altered by the Metropolis Management (Amendment Act), 1885, (48 and 49, Vict., c. 33). In urban and rural sanitary districts, the urban and rural sanitary authorities are the local authorities for the purposes of the Electric Lighting Acts.

It is important to notice that, by the London Government Act, 1899, the whole administrative County of London is to be divided into metropolitan boroughs, and for that purpose it is made lawful for Her Majesty, by Order in Council, to form each of the areas mentioned in the 1st Schedule to the Act into a separate borough. Whenever such a borough is constituted, the powers, duties, and liabilities of the elective vestry shall be transferred to the new Council of the borough.

Consent of Local Authority.

By Section 3 of the Electric Lighting Act of 1882, the Board of Trade is empowered to license . . . . any company or person to supply electricity within any area, subject to the consent of the local authority to such application first had and obtained. By the Act of 1888, Section 1, this consent is now required in the case of a provisional order also; but if it is refused, the Board of Trade have power to dispense with the same where they are of opinion that, having regard to all the circumstances of the case in which the consent of the local authority is refused, such consent ought to be dispensed with. No provisional order shall authorise the supply of electricity by any undertakers within the district of any local authority unless notice that such provisional order has been, or is intended to be applied for, has been given to such local authority on or before July 1st in the year in which such application is made.

Powers of.

Of the supervision which the local authority may exercise over the undertakers, the following sections will furnish examples:—

By Clause 9 of the form of Provisional Order under the Act of 1882 and 1888 (now reproduced in Clause 10 of the schedule to 62 and 63 Vict. c. 19), the local authority may, by withholding its consent, prevent the undertakers from placing any electric line above ground, except within the premises in the sole occupation or control of the undertakers. In the event of such lines being laid without the sanction of the local authority, application may be made to a court of summary jurisdiction, which can order the defendants to remove the wires. [E L.A., 1882, Section 14.]

By Clause 11 of the form of Provisional Order under the Acts 1882 to 1888 (see now Clause 13 of the schedule to the Electric Lighting Clauses Act, 1899), no box or apparatus shall be placed above ground, except with the consent of the local authority, body, or person by whom the street is repairable. The local authority may also, with the approval of the Board of Trade, prescribe the hours during which the undertakers are to have access to such boxes. If the undertakers remove or displace such boxes without the consent of the local authority, they become liable to certain penalties. The following case will give some idea as to what are considered to be boxes. In the case of the Wandsworth District Board of Works *v.* County of London and Brush Provincial Electric Lighting Company [*Journal of Gas Lighting*, August 13th, 1895, Vol. 65, page 345], the company sought to excavate and construct certain large chambers under the streets for the purpose of containing transformers. The chambers proposed to be used were 10 feet deep, 7 feet 6 inches long, and 5 feet 6 inches wide. The local authority contended that these were not "boxes" within the meaning of the provisional order, and further, that they could not be used for the purpose of holding transformers. Stirling, J., refused to grant an injunction restraining the company from making these excavations.

Chambers may also be constructed in churchyards, and a faculty will be granted for the purpose. [Shiress Will on "Electric Lighting," page 137.]

Compulsory Purchase.

By Section 27 of the Act of 1882, it was provided that where undertakers were authorised by provisional order or

special Act to supply electricity within any area, the local authority of the district might, after the expiration of a period of 21 years, or after every subsequent period of seven years, purchase, compulsorily, the undertaking upon the terms "of paying the then value of all lands, buildings, works, materials, and plant, suitable to and used by them for the purpose of their undertaking," nothing being allowed for compulsory purchase or goodwill; such value to be determined, in case of difference, by arbitration. It was soon found that these terms offered no inducement to the enterprise of electric lighting. Accordingly, by Section 2 of the Electric Lighting Act, 1888, the section above referred to was repealed, and a new section for effectuating purchase was substituted, in which the period of 21 years was changed to 42 years, and the recurring period from seven to 10 years. The Act of 1888 also provides that upon such purchase all lands, buildings, works, materials, and plant of the undertakers shall vest in the local authority, freed from any debts, mortgages or similar obligations of the undertakers, and that the powers of the undertakers shall absolutely cease and determine, and shall vest in the local authority.

It should be noticed that (by Section 2) the local authority are empowered to acquire an undertaking within six months after the expiration of a period of 42 years, *or such shorter period as is specified in that behalf in the provisional order or in the special Act.* By this means the local authority, whose consent, be it observed, is to all intents and purposes a condition precedent to the grant of a provisional order by the Board of Trade, have it in their power to make terms with undertakers which shall provide for the taking of the installation over by the local authority within a much shorter period than 42 years.

Again, where the local authority are entitled to demand a sale within a period of 42 years, or any less period as specified in the special Act or provisional order, they may exercise their option after every recurring period of 10 years.

The undertakers are compelled to sell all lands, buildings, works, materials, and plant of such undertakings suitable to, and used by, them for the purposes of their undertaking within the jurisdiction of the local authority, the values in case of difference to be settled by arbitration, subject to the *value* being regarded as the fair market value at the time of the purchase. Regard must also be had (1) to the nature and condition of the buildings, works, materials, and plant; (2) to their state of repair; (3) to the circumstance that they are in such a position as to be ready for immediate working; (4) to their suitability to the purposes of the undertaking; (5) to the loss occasioned by severance, where a part only of the undertaking is acquired by the local authority (*e.g.*, in cases where only a part of the system is within the jurisdiction of the purchasing local authority). No addition, however, is to be made in respect of compulsory purchase, or of goodwill, or of any profits which may, or might have been, or be made from the undertaking, or of any similar considerations.

This is the clause which appears to press with the greatest hardship on the proprietors of electric lighting installation. The absence of a clause providing for an allowance of 10 per cent. over and above the purchase money, by way of compensation for compulsory purchase, has done much to stifle electric lighting enterprise on the part of private companies.

With the exception of the determination of the price, all other questions arising between the parties are to be settled by the Board of Trade, who may also fix the date from which the purchase is to take effect, upon which date all lands, buildings, works, materials, and plant of the undertakers shall vest in the local authority which has made the purchase. The property becomes vested in the local authority freed from any debts, mortgages, or similar obligations of the undertakers.

It is important to notice that, by Section 3 of the Act of 1888, notwithstanding anything in the last preceding section contained, the Board of Trade may, by any provisional order to be made by them under the Electric Lighting Act, 1882, vary the terms upon which any local authority may require the undertakers to sell. It is conceivable that, under this section, the Board of Trade might have power to decree the payment of some small sum by way of compensation, for it is expressly said that "the Boards shall have power to vary the terms, notwithstanding anything in Section 2."

There have not been many cases relating to sale compulsory of electrical undertakings. A case from Sheffield, in 1897, serves to show that the provisional order may provide for payment otherwise than in cash, and that, unless the corporation or local authority in question has statutory power to make payments in such a manner, the power of compulsory sale may fall into abeyance.

A provisional order, authorising an electric lighting undertaking, came into operation on June 27th, 1892. It gave the Corporation of the City of Sheffield power to purchase the undertaking compulsorily on terms of issuing or transferring to the undertakers such an amount of the Corporation stock as will produce, by the interest thereon, "an annuity of 5 per cent." on capital properly expended. Another provisional order, coming into operation June 28th, 1892, took away a power the Corporation had, but had not exercised, to issue irredeemable stock. The statutes confirming the two orders received the Royal Assent on June 27th, 1892. It was decided that the statutory price for the undertaking was an amount of irredeemable stock; and that the Corporation were not, by implication, authorised to issue irredeemable stock for the purpose of purchasing the undertaking; and that, therefore, the power to purchase compulsorily was, so long as the Corporation had no power to issue irredeemable stock, in abeyance. [Sheffield Corporation *v.* Sheffield Electric Light and Power Company (1897), W. N., 171; 77 L. T., 616.]

The above is an outline of the main provisions which must regulate contracts between the local authorities and undertakers. Apart from their power to take over the whole system, the municipality is empowered by the provisional order to exercise a somewhat strict supervision over the doings of the undertakers. The general nature of this supervision is to be found in the Electric Lighting (Clauses) Act, 1899, an abstract of which was published in the Electrical Review for September 15th. It comprises a schedule which is in effect a reproduction of the form of provisional order so well known in connection with the Electric Lighting Acts, 1882 to 1888. It is important to observe that this Act does not apply to the County of London, except in so far as any of the provisions contained in the schedule are incorporated with any provisional order made by the Board of Trade under the Electric Lighting Acts extending to the County of London. It would be impossible, within the scope of the present article, to deal with the numerous points where the local authority is likely to come into contact with the undertakers. We have endeavoured to point out the legal incidents to the compulsory sale which undertakers may be compelled to make the local authority.

LONDON COUNTY COUNCIL.

The Council on Tuesday postponed the consideration of a recommendation in favour of approval being given to the draft form of light railway order as circulated among the members with regard to the various light railway schemes already decided upon at a recent meeting.

London United Tramways.

The adjourned report of the Highways Committee, the consideration of which had been adjourned on two or three previous occasions, was again submitted in reference to the London United Tramways Act, 1899. It may be recollected that the Committee recommended the Council to approve plans forwarded by the company for the introduction of the overhead trolley system on the tramways in the Uxbridge Road between the Askew Arms public-house and the Uxbridge Road railway station, and in Uxbridge Road and Goldhawke Road between the railway station and Young's Corner, and for the adoption of the conduit system on the tramways between Young's Corner and Hammersmith Broadway, and thence along Beadon Road, Glenthorne Road, and Studland Road, and that part of The Grove between Beadon Road and King Street West.

To some surprise the recommendation was again deferred. It is thought that further negotiations are proceeding with the Hammersmith Vestry on the subject of extending the overhead system.

The Westminster Electric Tramway.

In a further report the Highways Committee reminded the Council of the recent decision to apply for Parliamentary powers to embank the Thames from Victoria Tower Gardens to Lambeth Bridge, and to widen Millbank Street to 70 feet. In connection with this scheme the Committee expressed the opinion that it was desirable to obtain powers to construct a tramway to be worked on an underground system, along Millbank Street on the completion of the widening of

that thoroughfare. It was estimated that the tramway, which would comprise about 500 yards of double line, would cost about £6,000. The Committee recommended that (*a*) standing orders should be suspended, so as to allow the application to be made to Parliament in the next session, and (*b*) that the Parliamentary Committee should be instructed to include in the Tramways Bill a clause to empower the Council to construct the tramway.

Reporting upon the financial bearings of the proposal, the Finance Committee stated that it was evident the tramway could only be suggested as part of a much larger project, and that they had no information at present to guide them as to the extent of the scheme which, it was presumed, would ultimately be brought forward. It was impossible, the Committee concluded, for them to make any forecast of the financial results until further particulars were forthcoming in relation to the proposed line.

The Chairman of the Committee having moved the adoption of the first recommendation,

Mr. T. B. Westacott expressed the hope that the Council would not agree to the proposal to suspend standing orders. It was not a recommendation of the Highways Committee, but only of three of the members of the Committee, the others having received no notice that the matter was to be considered by the Committee. The question had never been placed on the agenda paper, and he asked the Council to reject the recommendation, more especially as neither the Improvements Committee nor the local authority had been consulted in regard to the matter.

Mr. Hatter said that after the statements of the previous speaker the Council should not agree to the suspension of standing orders. He then referred to the remarks made by the Finance Committee on the subject in order to show the indefiniteness of the proposal. The scheme was merely for a tramway from the House of Lords to Lambeth Bridge. It was, perhaps, only part of a larger project for tramways down the Grosvenor Road and along the Chelsea Embankment, but the Committee ought to prepare a complete scheme for the Council before proceeding with the recommendation.

Mr. J. W. Benn, chairman of the Committee, stated in reply to Mr. Westacott, that the Council would remember a question was put by Mr. Johnson to the Improvements Committee on October 24th, as to the desirability of a tramway being constructed along the widened Millbank Street. The matter was before the Highways Committee on two occasions, but he did not know whether Mr. Westacott was present. It was the privilege of the chairman to bring up in committee matters of emergency without their being placed upon the agenda paper, although he considered the member had had sufficient notice by Mr. Johnson's question. By adopting the proposal, the Council would only be continuing the policy pursued in connection with other schemes, as, for instance, the proposed tramway over Vauxhall Bridge, and he presumed also over the new Lambeth Bridge. He could not see any objection to the Council obtaining powers, but if they embarked upon the improvement scheme without the tramway, the Council would seriously handicap the development of tramways in London. Of course, the proposal was only part of a larger scheme for the south side of the metropolis.

On a division, 56 voted in favour of the recommendation and 28 against.

Lord Welby, chairman of the Council, said that the number in favour was not a sufficient majority to carry the motion, and he declared that the second recommendation would accordingly also fall to the ground.

The Council's Electric Traction Bill.

In compliance with standing orders, the consideration of the following report of the Highways Committee was adjourned until the next meeting:—

The Council has made application to the Board of Trade for a license under the London Tramways Act, 1888, for the use of electrical traction on the tramways between Westminster Bridge and Tooting. It has since been represented to us that it is doubtful whether, if this license were granted, the Council would have power, without further Parliamentary authority, to interfere with the public streets for the purposes of the necessary reconstruction of the tramways; and, as we attach great importance to this line and also the line from the junction at the "Horns" public house at Kennington to Blackfriars Bridge being reconstructed as a first experiment for electrical traction on the Council's tramways, we think it advisable that Parliamentary powers should be sought for the purpose in the Tramways Bill to be promoted by the Council next session. The line from Westminster to Tooting is about six miles in length, and the cost of reconstruction is estimated at about £191,400, while the length of the line between Blackfriars and Kennington is about two miles, and the estimated cost is £59,400, the estimate in each case including the cost of rolling stock and a proportion of the cost of mains, plant, and power house. Both of these lines are double throughout. We have, in accordance with the standing orders, informed the Finance Committee of our intention to submit this proposal to the Council; and we recommend:—(*a*) That the standing orders limiting the period for considering applications to Parliament be suspended, so far as may be necessary, to enable the Council to consider the following recommendation:—(*b*) That the Council do seek powers in the London County Tramways Bill, to be promoted in Parliament next session, for the reconstruction, for electrical traction, of the portions of the London County Council Tramways (*a*) between Westminster Bridge Road and Tooting, and (*b*) between Blackfriars Bridge and the tramways junction near the "Horns" public house at Kennington.

CORRESPONDENCE.

The Berrenberg Lamp.

I read with great interest in your current number a review of an article appearing in a contemporary anent the new factory of the Berrenberg Electric Lamp Company, Limited, at Southfields.

While fully agreeing with the writer that a 2½-watt lamp, having a life of 1,000 hours, is the lamp all consumers of current are praying for, I totally differ from his method of endeavouring to ridicule the claim of the Berrenberg lamp to give such results. He has evidently read the advertised claim of the lamp to save from 5s. to 15s. per lamp, according to cost of supply units. The advertisement is probably badly drawn and requires the additional words "per 1,000 hours burning" to complete its full sense, but this meaning is so apparent that I can scarcely conceive qualified engineers reading it otherwise.

The writer, however, has very foolishly walked into a simple trap, when he says "how can this amount be saved, when central station statistics show that the average 'annual' charge for current for one 8-C.P. lamp comes to only 8s?" Some lamps (such as I have seen in large pantechnicon warehouses) are not switched on once during the whole year, whereas the cost of many 16-C.P. lamps will exceed £3 and £4 in one year. It is apparent, therefore, that station statistics of average lamp demand is a matter totally foreign to the question of lamp efficiency, and as your contributor proceeds to sum the matter up rather warmly for the poor lamp manufacturer, I think he will see an explanation of his mistake would only be scant courtesy.

For my part, comparing the claims made by this lamp of 2½ watts (presumably averaging this figure for the 1,000 hours), I consider that the fully 2 watts advantage claimed over all other lamps of long life I know of allows the makers in question to claim an even larger saving than they do, startling and almost incredible as the figures are.

Engineer.

[Our correspondent's enthusiastic support of the Berrenberg lamp—which we did not attack in any way—has caused him to jump to hasty conclusions. There was no ridicule in our note, nor did we dispute the efficiency definitely claimed for the lamp. But we took exception to the vague statements whose "meaning is so apparent," but which, like all half truths, are so misleading.

The person who is most interested in the cost of the energy absorbed by his lamps is not the qualified engineer, but the innocent consumer, who cannot discriminate between what is written and what is meant. The average annual charge per 8-C.P. lamp is, as stated, 6s. or 7s. (not 8s.). Assuming that the Berrenberg lamp takes 2·5 watts per C.P., as against the 4 watts per C.P. required by good lamps of other makes, the annual saving amounts to about 2s. per 8-C.P. lamp.

To justify the statements under discussion, we must take a lamp of double the candle-power and burning for double the time of the 8-C.P. lamp mentioned above—which bears out our prediction. Our correspondent's references to exceptional instances do not affect the issue. The statements were perfectly general in form, and must be applied to the average case.

We may point out, however, that a 16-C.P. 60-watt lamp burning for 1,000 hours, at 3d. per unit, can only cost 15s.; even at 5d., an exorbitant charge for long-burning lamps, it cannot cost more than 25s. The £3 or £4 referred to by our correspondent, therefore, must be understood to imply three or four new lamps for renewals also. As for the "2 watts advantage claimed," we are pleased to know that this is the precise amount, as the makers did not tell us.—Eds. Elec. Rev.]

High and Low Speed Motors.

May I be allowed a few words in continuation of my letter of October 20th concerning high and slow speed motors? I observe that in your issue of November 3rd, one of your contributors does me the honour of differing (on page 708) from my statement as to the value of the slow speed motor referred to in my letter mentioned above.

Although I dissent from his views on many of the other points he mentions, these are, in some instances, matters which are open to argument; I imagined, however, that the current market value of any machine was a matter of actual fact, which could easily be verified.

However, as your contributor disagrees with this view, I shall have the greatest pleasure in affording him an opportunity of proving the value of his opinion by backing

it, and I hope that you, Sir, will be kind enough to act as arbiter, and that the following proposal will meet the views of the writer of the article above referred to :—

I am willing to bet £10 even, that I can prove to your satisfaction that an old-established firm of English manufacturers of the highest standing, are prepared to supply slow speed motors, of the power and speed mentioned in your original article and in my previous letter, at a price not exceeding that mentioned by me. I may add that the firm referred to is not by any means a cheap one. To avoid opening your serious pages to the reproach of being a medium of gambling, I suggest that the winner can contribute to one of the admirable funds for the widows and orphans of soldiers, and I trust for the sake of charity, that your contributor's courage may be equal to his confidence, and that this opinion may have a better foundation than most of the others advanced in his article.

To turn to another matter; in your last number, on page 782, you take exception to the statement in Mr. Raworth's paper that it "might take 20 1-horse motors to do the work of one 10-horse motor driving the lot," assuming all the machines are at work simultaneously. Possibly Mr. Raworth himself may make plain this hard saying, but in case he does not, I venture to point out that there is at least one well-known case of frequent occurrence, in which the conditions he states apply, that is, when the power taken by the driven machines varies during the stroke; in such a case, each machine, if equipped with a separate motor, requires sufficient power to take it over the hard point of the stroke, while with one large motor driving a line shaft enough power for 20 per cent. or 25 per cent. of the whole number of machines on the hardest point need be allowed; the fly-wheel action of the whole system will help it over any abnormal instantaneous load. As regards the price of current at which electric driving can compete with gas or steam, this naturally varies in almost every case, even in the same trades, but it may be of interest to you to know that in one instance, at least, electricity at 3d. per unit has been found to be considerably cheaper than gas at 2s. 6d. per 1,000 cubic feet, the gas engine driving through shafting and belts, and the motors being attached direct to each machine.

The fact appears frequently to be lost sight of that the true comparison between separate motors and grouping, requires to be made on the basis of ascertaining not only whether separate motors are more economical, but also whether the saving they make will pay the capital charges on the extra outlay involved. That is a large subject, however, and needs an article to itself, written by one who knows his subject.

Lente.

Single-phase Motors.

In answer to Mr. Eborall's letter, which appeared in your issue of the 20th ult., I beg to state that my firm has for many years put on the market motors to give, if anything, better results as regards starting and guaranteed current consumption than those given in the description of the Heyland motors.

Coming now to Mr. Heyland's letter in your issue of the 27th ult., it has for many years been a well-known fact to me that, for producing a large starting torque, it is advantageous to give the starting winding less turns than the working winding, and we have made use of this wherever a great starting torque was required.

C. E. L. Brown.

Overhead Electric Tramway Equipment.

As a reader of this journal will you allow me to ask through its columns whether rail bonding, pole planting, overhead trolley wiring, and the work in fitting the overhead equipment is an art or needs any study.

The reason I am asking this question is, because some district surveyors in the town where I am doing the above work say that it needs no experience; that it is neither an art nor is it science. Having been on tramway work for over seven years, I shall be very pleased to hear some other persons' verdict.

I myself say that pole planting alone requires a man of experience. I also say that as simple as rail-bonding looks, that it is an art if a proper connection is to be made. Trusting you will kindly refer to this.

A Working Electrician.

[Of course experience is necessary, just the same as in the case of overhead telegraph wire construction.—Eds. Elec. Rev.]

Improved Trolley Poles.

The question that arose in my mind on first reading your notice of the above invention, was the method of successfully negotiating the section insulators, and I venture to think that the difficulties suggested both by "W. H. S." and "R. T. W.," are insignificant as compared with this latter.

H. C. B.

Foreign Competition.

As the question of foreign competition is now very much to the fore in this country, we think the following facts may have some interest for your readers.

In October, 1897, we, with other electrical cable makers, were invited by the Dublin United Tramways Company, Limited, to tender for the cables required in connection with the conversion of their tramways from horse to electric haulage.

The specification—written by the tramway company's consulting engineer, Mr. Parshall (an American)—was issued to us, providing, among other things, that the price quoted for the cables was to be inclusive of the drawing into the conduits in Dublin, and the jointing up and putting to work, and that delivery was to be made of the whole of the cables within nine months of the date of the order.

We tendered to the specification, in due course, offering to carry out the whole of the terms and conditions set forth in every particular, but received a notification from the secretary of the company on January 29th, 1898, to the effect that our tender had not been accepted.

So far, we had, of course, no ground for complaint, but we subsequently heard that the order had been placed with an American firm, the National Conduit and Cable Company, for paper-insulated cables, and as we held the patents for this class of material for this country, we entered an action for infringement as soon as the first cables were delivered.

This action has recently been tried, and has resulted in our favour. During the proceedings it was necessary for the tramway company to produce a copy of the contract they had made with the American firm, and it is particularly to this contract that we wish to draw attention.

We attach a copy of the contract herewith, and it will be noted that its conditions differ in many respects from those to which the English manufacturers were asked to quote.

Notably, the contract is made in America, and the tramway company took delivery of the cable in New York, this step being presumably an attempt to deprive the English manufacturer of the rights under his patent.

The tram company loaned to the National Conduit and Cable Company the services of their engineer (Mr. Parshall) to supervise the drawing in and jointing, so that this work, although carried out at the contractor's expense, has not been effected by him, as provided for in the original specification.

We understand that we were to provide over the lead sheathing of the cables a layer of compounded jute yarn, although for cables that are to be drawn into "ways," it is our practice to provide a plain lead covering only. We find that the American firm have provided plain lead-covered cables, thereby, of course, effecting a considerable saving in the cost.

We would then draw particular attention to the remarkable fact that blanks have been left in the contract both for the quantities of cable and the sizes, and prices at which they are to be supplied.

No time for delivery is stated, and, as a matter of fact, the American firm has largely exceeded the time allowed to the English manufacturers.

The guarantee clause expressly excludes electrolytic damage,

although we were asked to include this possible cause of damage in our undertaking.

We are content to leave the matter to the judgment of the public.

The British Insulated Wire Company, Limited.
G. H. Nisbett.

November 14th, 1899.

[copy.]

This agreement made by and between the National Conduit and Cable Company, a corporation organised and existing under and by virtue of the laws of the State of New York, United States of America, with its principal business office in the City of New York, party of the first part, and the Dublin United Tramways Company, a corporation organised and existing under and by virtue of the laws of the United Kingdom of Great Britain and Ireland, and having its principal business office in the City of Dublin, Ireland, party of the second part.

Witnesseth:—That whereas the party of the first part is the manufacturer of and dealer in certain electrical conductors or cables known as "paper-covered cables," and whereas the party of the second part is a common carrier, operating and propelling its tramcars by means of electricity, and is desirous of purchasing said cables from said party of the first part for the purpose of transmitting electricity from the power station to said tramcars and otherwise.

Now, therefore, in consideration of the sum of $1, each to the other paid, the receipt whereof is hereby acknowledged, and of the covenants and promises hereinafter contained, the parties hereto covenant and agree as follows:—

The party of the first part agrees to sell to the party of the second part, and the party of the second part agrees to buy from the party of the first part feet, more or less, of the cable manufactured by the party of the first part, to be delivered to the party of the second part on board ship at the port of New York, said ship to be designated by the party of the first part. The size and price of the cable which the party of the first part agrees to sell to the party of the second part is as follows:—

The party of the second part agrees to pay for the said cable on the certificate of their consulting engineer, in New York funds, through Comptoir National d'Escompte de Paris, London, as follows:—

Fifty per cent. upon the arrival of the shipment in London, 40 per cent. when the circuit is jointed up in the subway, and the balance of 10 per cent. upon the completion and the acceptance of the cable in the subway.

It is further understood and agreed that the aforesaid cable shall be laid, installed, and connected up, under the direction of the engineer of the party of the second part, but at the cost and expense of the party of the first part.

It is further understood and agreed that the party of the first part shall furnish the party of the second part its guaranty and bond, guaranteeing the durability of the cables furnished by it as aforesaid, except as against the act of God, the public enemy, mechanical injury or electrolysis, for a period of ten (10) years from the date of acceptance, and that the said party of the first part shall also furnish its guaranty and bond for the purpose of indemnifying the party of the second part against damages incurred for infringement, because of the use of the cables purchased as aforesaid from the party of the first part; the party of the first part, however, to be notified by the party of the second part so soon as, and as often as, any action or proceeding is threatened involving the patentability of said cables.

In testimony whereof, the party of the first part has caused its corporate name to be hereunto signed by its and its corporate seal to be hereunto affixed with the attest of its on the day of March, 1898, and the party of the second part has hereunto caused its name to be signed by its president, and its corporate seal to be hereunto affixed, with the attest of its secretary, on the 11th day of March, 1898.

The Dublin United Tramways Company,
By Wm. Anderson,
Secretary and Manager.

Seal. Attest.
R. S. Tresilian, A. Secy.

The National Conduit and Cable Company,
By Edward S. Perot, President.

Seal. Attest.
Geo. J. Jackson, Secretary.
In the presence of Jas. H. Warner.

State of New York,
City and County of New York } Ss.

On this 11th day of March, 1898, before me, Henry B. Heylman, a Notary Public in and for the county of New York, appeared Edward S. Perot and George J. Jackson, to me known and known to me to be respectively, the president and secretary of the National Conduit and Cable Company, and who, being by me duly sworn, deposed and said that they were the president and secretary respectively, of the said the National Conduit and Cable Company, and had been duly authorised by the board of directors of said company to execute the foregoing instrument in the name of and for the aforesaid company, and acknowledged that they executed the within instrument and affixed the corporate seal thereto for the purposes and intents therein expressed.

Henry B. Heylman,
Notary Public (198),
N.Y. County.

Electricity Supply!

Engineers in the electrical business are wont to sniff disdainfully at any suggestion that the electric lighting industry is in its infancy, but the experience of the last few weeks is evidence that, at any rate, the company from which I obtain a fitful supply of current must be infantile—or, at least, puerile—to call itself a supply company when it provides little else but interruptions. The Blackheath and Greenwich District Electric Light Company not being yet ready to give current from its own station, are buying it from the London Electric Supply Company, and if the people in London are not getting a better supply than we do in this suburb, they have my sympathy. There have been four total extinctions in the last six days, one lasting for two hours, and during the greater part of the evening the pressure is just sufficient to make the lamps look like red-hot hairpins. Now, if this was 1889 instead of 1899, one would not think so much about it, or if the London Electric Supply Company would call its pressure what it is, instead of what it ought to be, I should know where I am; but one does not want, at this period of the nineteenth century, to go to the expense of having one's house fitted for the electric light and then find that the industry is so much "in its infancy" that it is necessary to watch its fitful struggles by the humble aid of the homely candle. Surely the supply company must have known that it had no current to spare before it undertook to supply this district.

A Believer in Candles.

Blackheath, *November 14th*, 1899.

Consulting Engineers and Contractors.

The question raised by your correspondents is by no means so simple as it appears. Every engineering manufacturer and contractor does a good deal of what is virtually consulting work. They advise their clients what is the best form of apparatus to use, what it will cost in work, &c., and often give detailed specifications of what they propose to supply.

Unfortunately this facility for obtaining information is very often badly abused, consumers often obtaining valuable information from sellers when they have not the slightest intention of placing the order with them.

Many firms also are in the habit of purchasing from one firm in a particular line, in whom they have confidence, and who are virtually their consultants for that particular branch.

In my own business I had a number of firms to whom I practically acted as consulting engineer. I kept them posted upon every new development in electricity, I advised them upon the best methods of carrying out any schemes they had in hand, and upon the suitability of different apparatus offered to them for their work. I received no consulting fee from them for this work, but I had what orders they had to give.

Apart from this also, the individual members of many contracting and manufacturing firms do a good deal of consulting work that is recognised and paid for as such, and which usually arises directly, or indirectly, from their business connection.

During nearly the whole of the 28 years that I was in business as a manufacturer and contractor, I had such a consulting practice running side by side with the ordinary business, and the consulting work nearly always came to me from clients with whom I was doing business regularly, in the ordinary way, and who had acquired confidence in my ability to advise them, or to report upon the matter in hand; or it came from recommendations by them.

A single instance will show the kind of work I mean.

A firm of dry dock owners, with whom I did business regularly, were repairing a petroleum ship in one of their docks when an explosion occurred on board, doing considerable damage.

The electric light was in use in the ship's hold, where the explosion took place, and I was called in to report: whether, if the cable supplying the lamps in the hold broke, a spark would pass to any part of the body of the ship? and if such a spark would ignite petroleum vapour if present? and I was required to attend the Board of Trade inquiry to give evidence if required.

Explosions of that kind, leading to similar commissions,

do not often occur, but there are numbers of similar cases where firms require the advice of an expert, and a friend they are constantly doing business with, in whom they have confidence, is the readiest available.

There are limits, of course, to this kind of thing. A firm of engineers may advise a firm who are requiring, say, an electric light and power plant, and may afterwards be employed to carry out their own advice; but it would be very much out of place for a firm of engineers to advise a local authority and to act as consulting engineers for the authority, and to be the contractors for the work as well. I believe, however, there are cases of this.

When a member of a manufacturing or contracting firm acts as a consulting engineer, it often leads to strange and occasionally somewhat comical experiences.

When I have been employed to prepare a specification for some particular work, I have had mutilated portions of my own specification sent me for a long time after, as newly drawn specifications, on which I was to tender for some proposed new work.

On one occasion, too, I was required to prepare all figures showing exactly what I intended to supply, even to the size of the cables, and to work out the operating cost of the different possible methods.

When my tender was accepted, the plan I advised was copied into the consulting engineer's specification, together with the other figures I had supplied, and I was solemnly required to agree to them.

Whether a man who is purely a consultant is entitled to have apparatus for his own use at trade prices, because "he is in the trade," is rather a difficult question. Probably he can always obtain all he wants at trade price, or thereabouts, but, I should say, it is very doubtful as to his being entitled to it.

The phrase "in the trade" is a very elastic one. Is a consulting engineer, who is advising, say, a cotton spinner, as to an electric power plant he is putting down for his mill, "in the cotton trade," or where he is advising a brewer, is he entitled to his beer at trade prices?

I remember once a jeweller claiming to have some work done for him at trade prices, because he had once fixed an electric bell for himself, and therefore he was "in the trade."

Sydney F. Walker.

Barnsley Electric Tramway Schemes.

My attention has been drawn to a paragraph headed "Barnsley" under Electric Traction and Motive Power Notes on page 759 of your ELECTRICAL REVIEW for last week, and I regret that you have assumed, without having made the slightest inquiry on the subject, that the Barnsley Town Council are guilty of unfair dealing.

The fact is, that the Barnsley Town Council have never, at any time, made an arrangement with the British Electric Traction Company, but, on the contrary, have opposed their proceeding from the beginning.

Henry Horsfield,
Town Clerk.

Barnsley, *November 14th*, 1899.

[While we are pleased to insert this letter, we would point out to the writer that we said "It does not say much for the fair dealing of the Council *if*" such and such a thing has been done. As that certain thing has not been done (as we gather from the above letter), then the Council is not open to the charge. Furthermore, we would add that our remarks were, as then indicated, founded upon statements appearing in a Sheffield paper. If we have hurt the feelings of the Barnsley Town Council, we repent in dust and ashes as heartily as we believe that some day the travelling public there will do, *if* they have to change at the boundary line from municipal car to company car, instead of being able to take an unbroken journey over a continuous system introduced by the company mentioned.—EDS. ELEC. REV.]

Electrical Distribution of Motive Power.

With reference to your article in last week's number, your figures proving that sub-division is necessary to make electric driving pay are based on your only taking into consideration the amount of current used. If you had only brought in another factor, viz., cost, you could prove exactly the opposite. Take the case in this district, where running normal hours, 1 H.P. costs about £10 a year. In one shop we have a 4½-H.P. motor driving 10 lathes, two milling machines, one drill, one slotting machine, one screwing machine, and a pair of emery wheels. If each of these had had a separate motor the cost would have been over £500, whereas the actual outlay would be under £100, so that on a running bill of £45 you would have had to have saved £60 to allow for interest and depreciation on the extra cost of motors.

In the case above, the tools are running constantly in the ordinary term of machine shop practice, and are driven off one shaft, which is driven from the motor. This shaft always running will take about 1 H.P., and the motor will give about 86 per cent. efficiency. Small motors coupled direct to the tools, and with reduction gearing, would waste quite as much power as the shaft and single motor does.

In the case of machines each taking 1 H.P., and comparing 20 of these with a motor driving 20 of them, if they ran steadily at full load throughout the day, you would have the same difference in first outlay, but of course a much bigger running bill, £200, out of which to pay for interest and depreciation, but even in this case if the shaft is well run and not over long, it should not cost more than £10 or £15 a year to run it, and the lower efficiency of the 1-H.P. motors will counterbalance this amount.

In our opinion, no general rule can be given; each job ought to be taken on its merits, and besides allowing for which takes the least current, allowance must be made for which costs the least at the end of the year, which is a very different thing.

Rosling & Appleby.

November 14th, 1899.

A New Incandescent Lamp Factory.

Having read the article under the above heading in your paper of the 10th inst., referring to the Berrenberg Incandescent Lamp Factory, in which you take exception to certain statements respecting our lamps, appearing in the recent issue of a contemporary, we shall be glad if you will kindly allow us space to reply.

As far as the article deals with the Berrenberg metallic vacuum pumps, we think it requires no further explanation than to call the attention of the writer to a description which appeared in your paper on February 24th, 1896, Vol. 38, No. 948, embodying a report by Prof. Ayrton, F.R.S, on our metallic vacuum pumps, which Mr. Berrenberg has since so greatly improved that the result is still more remarkable, and he continues to make gratifying progress in this direction.

With regard, however, to the claims we make for our lamps, one fault urged against us appears to be that we have not dotted our i's or crossed our t's, as, in referring to the consumption of current, your contributor has interpreted our figures to mean the consumption of watts per lamp instead of watts per candle. Speaking about the heat, we would like your readers to judge for themselves by burning one of our lamps in water and taking the temperature, and then comparing it with that given off by another make under similar conditions. With regard to the saving effected by using our lamps, independent tests show in taking 16 C.P. 100-volt lamps lasting 1,000 hours, according to the watts per candle consumed, our lamps save from 5s. to 15s. per lamp, according to the price of the current used during that time. We do not speak of "annual saving," for the lamps may be burnt continuously, or, on the other hand, they may last several years before the 1,000 hours is reached.

Since Goebel made the first incandescent lamps in 1854 in New York, comparatively slight improvements have been effected in them. Mr. Berrenberg tested some of Goebel's lamps in Boston in 1891, which consumed 4·3 watts per candle, and many of the lamps in general use to-day cannot give a much better result. This is owing in a great measure to the ignorance or indifference on the part of the ordinary consumer as to the essentials of a good lamp, and, again, to the supply companies, whose chief object appears to be to sell as much current as possible. Without doubt the most economical lamp at present to use is one consuming from 1½ to 2 watts per candle, with a medium life of about 300 to 600 hours respectively, as the following figures will show.

The current is calculated at 6d. per unit for better comparison with the prices actually paid, which can be adjusted accordingly:—

		s.	d.
16 c.p. 1½ watts for 1,000 hours = 24 units at 6d.	=	12	0
3 lamps at 1s. 6d.	=	4	6
		16	6
16 c.p. 2 watts for 1,000 hours = 32 units at 6d.	=	16	0
1½ lamps at 1s. 6d.	=	2	3
		18	3
16 c.p. 2½ watts for 1,000 hours = 40 units at 6d.	=	20	0
1 lamp at 1s. 6d.	=	1	6
		21	6

Mr. Berrenberg, having devoted years of labour to the subject, has, with the assistance of this company, succeeded in producing the above-mentioned lamps, which are far superior to any on the market, and we think that such efforts should receive due recognition at the hands of such journals as yours, instead of treating with ridicule our statements and referring to them in the following terms: "Such exaggerations recoil on the head of their perpetrator in the long run, and at the same time discredit the trade in general"—which last statement the writer thereof should bear in mind.

The Berrenberg Electric Lamp Syndicate, Limited.

[While our correspondents make clear their meaning, they do not refute our criticism of the loose wording of their announcements, which might just as easily have been accurately framed at first. Far from ridiculing them, we heartily welcome real efforts towards progress.—Eds. Elec. Rev.]

LEGAL.

The Electric Construction Company, Limited, v. The Imperial Tramways Company, Limited, The British Thomson Houston Company, Limited (Third Parties).

On Thursday, November 9th, the hearing was resumed in the Chancery Division of the High Court of Justice, before Mr. Justice Cozens-Hardy, of this action.

Mr. Astbury called, as a witness, Mr. John Imray, described as a civil engineer of large experience, who said he had considered the plaintiff's specification, and also the various specifications which had been referred to in the course of the trial, by way of anticipation. With regard to plaintiff's specification, witness said that if other forms of gearing, such as belts or friction clutches were used, there would be no necessity at all for springs. The mechanical object of springs was to take off shocks, and that was a matter well known in mechanics long before the date of plaintiff's invention.

What were the understood means of avoiding shock?—Usually buffers, strong things which would take off the blow. Springs were perfectly well known for that purpose.

In further examination, Mr. Imray said that, in his opinion, there was no difference, except in detail, between the way in which Reckenzaun supported his motor and that of the plaintiff, taking away the right-hand spring and leaving the left-hand spring, the two methods were precisely the same. With the exception of the spring attachment, he found all the elements of plaintiff's invention present in Finney's specification, and performing the same functions.

Mr. Imray was next questioned as to a picture plan of Sprague's invention as shown in the United States Official Gazette.

If anybody were told to make a motor as shown in the Gazette, and supply the commonest form of part to avoid vibration, what would he do?—He would put springs to where the motor is attached to the truck. It was a usual thing at that date to put springs to support the carriage.

Supposing the field magnet is hung from the car body itself, instead of being hung to the cross piece, what would be the effect of the springs of the car body upon the magnet, having regard to the fact that it was sleeved at the other end?—If you put the car body on springs there would be no need for springs to hang the car motor. Comparing Hermant's with the claim 3 of plaintiff's specification, witness considered the former was designed to solve the same problem as plaintiff's. The one essential of the plaintiff's, where he had tooth gearing, was that the two shafts, the armature shaft and the main driving shaft, must always be kept at a constant gearing distance, and that was provided for in Hermant's.

Cross-examined by Mr. Fletcher Moulton, Witness said he certainly did suggest that Reckenzaun's was a case of sleeving if you took out the springs.

I was speaking of it with springs, and I put it to you that no mechanician would ever describe that as sleeved.—He might not say "sleeved," he might say centred.

His Lordship: Centred or sleeved, do they mean the same thing?—It depends entirely on how the portions come into play.

Mr. Moulton: Sleeving is a mode of centring?—Yes.

The effect in producing swivelling is the same?—Yes.

In further cross-examination, Witness said there were no springs shown at all. As regards Sprague's (U.S.A. Official Gazette), supposing there was a rigid attachment to the car body by two links instead of springs at the other end and the car body rocked there would be a twisting action. Supposing they had springs from the other end and the car body was on springs, the movement of the car body rocking would compel the motor to go askew.

Pyott had no springs on his front or hind axle, but he put springs on his centre axle.

Re-examined by Mr. Cripps, witness said supposing you had a steam motor with a gearing apparatus, you must get the driving and driven wheels at constant distance, just the same as in an electromotor.

Mr. Wm. Worby Beaumont, M.I.C.E., &c., was next called for the defence. He said he had considered the problems in this case. With regard to the drawing in the Official Gazette, he agreed with Mr. Imray as to the indications of springs. He agreed that any engineer accustomed to that class of work would at once assume that there was something there of the nature of a buffer. Something of the sort was indicated in Adams's specification, and in the plan of Cryder. He agreed generally with the evidence of Mr. Imray as to the various other specifications.

Mr. Fletcher Moulton, in cross-examination: You have told his Lordship that Reckenzaun's is the same as the plaintiff's invention. Do you withdraw it?—No.

I do not know whether you were speaking of Reckenzaun's with or without springs?—I was speaking of it without springs.

Re-examined by Mr. Cripps, Witness deposed that he found in Reckenzaun's all the four elements, plus the spring, in the plaintiff's claim 1.

Mr. Astbury said that he had Prof. Silvanus Thompson present to give evidence if necessary, but he did not propose to call him or any other expert. The learned counsel then addressed his Lordship on the evidence which had been given, and submitted that the plaintiff's specification had been anticipated heaps of times.

Mr. Moulton, in reply, said he did not think that the construction of the plaintiff's claims would be difficult, if his Lordship would bear in mind one principle which had been laid down again and again in the judgment of the different courts, namely, that in interpreting the specification the claims were not to be interpreted as if they stood alone, but both for and against the patentee, his Lordship was bound to take into consideration the whole text of the specification in construing the claim.

His Lordship: I must construe the whole document, no doubt. I do not think that can be disputed.

Mr. Cripps said that he should not dispute that for a moment.

Mr. Moulton then referred in detail to the plaintiff's specification, and he said he paraphrased the claim in the following way—Handford said he hung the off end of his motor by springs from the truck, and he centred the other end on the driving axle. He then had springs connected with the truck, which would take off as much weight as the inventor chose by means of his adjustment. In the plaintiff's invention there were three elements. One end of the motor was suspended on springs and the other end centred and the weight was taken off by supporting springs. The inventor seemed to have attached some importance to his description of his special way of supporting the armature, but he (counsel) did not care about that, as he did not think it was material now. With regard to the alleged anticipation, the learned counsel submitted that he had called evidence of the very greatest value as to the position of this invention. In the first place, it proved that there was no common knowledge at the time which would lead people to do what the plaintiff's invention did. The evidence also proved that no less than five attempts had been made to mount an electric motor prior to the plaintiff's, but they all could be distinguished from that invention. His Lordship had to consider the special requisites of the electric motor as contrasted with the steam motor, and that would not allow any specification for a steam motor to be an anticipation of plaintiff's patent. Beyond that there was direct and uncontradicted evidence to show that nothing in those anticipations with regard to steam had become part of the knowledge of engineers. He submitted that the plaintiffs had proved the value of the patent.

Mr. Justice Cozens-Hardy said he would take time to consider his judgment, and asked to be furnished with copies of the shorthand notes which had been taken during the hearing.

Judgment.

Judgment was delivered on Tuesday, the 14th inst. His Lordship said:—

In this case, the plaintiffs sued as assignees of a patent for improvements in motors for electric railways, granted on August 10th, 1885, the alleged inventor being Mr. Sprague, an American. In the course of the present litigation the patent had expired, and the plaintiffs, therefore, had been obliged to limit their claim to one of damages. The defendants had clearly infringed this patent, assuming it to be valid, and the only issue really tried before him had been as to the validity of the patent. Defendants alleged want of novelty, and relied upon a large number of anticipations. The evidence of the scientific witnesses on both sides mainly dealt with the alleged anticipations. It was not required, except to a very slight extent, for the purpose of assisting him (the Judge) to construe the specifications, that he should go through them in detail. He apprehended that a specification ought to be regarded in the same manner as any other document which had to be interpreted by the Court. It must be looked at as a whole. The claims must not be looked at as if they stood alone. Strained and unnatural interpretation must be avoided. The true meaning and extent of the claims must be looked for without reference to the effect that

this may have upon the validity of the patent. The patentee began his specification by describing the object of his invention, and he then proceeded to describe how that object was to be accomplished. His Lordship quoted passages on these heads from the specification, and said it seemed to him to show that heavy springs were prescribed when, and only when, there was a truck upon the car, and that where the car had no truck the yoke, or back-piece, might be hung from the car body itself, and that springs were not needed. He might add that the evidence satisfied him that what he took to be the view of the patentee was mechanically correct. The patentee then proceeded to describe other parts of the invention, and next indicated the mode by which the dead weight of the motor on the driving axle could be relieved. He (the Judge) thought that the plaintiffs' counsel were right in saying that that was an optional arrangement, and that it did not refer to springs attaching the yoke, or the back-piece, to the truck. These "supporting springs" might be used with a truck or without a truck. The patentee then pointed out that the mode of gearing by toothed wheels was not essential, and next referred in detail to the figures annexed to the specification, and he might observe that all the figures showed trucks, and that there was no figure of a car body without a truck. It was not necessary to read all that part of the specification, and he would pass on to the three claims, which required very careful consideration. The first claim was for "the motor of an electric railway car or carriage, having (*a*) its field magnet centred or sleeved upon a driving axle; (*b*) its armature supported directly upon the field magnet; (*c*) and having a shaft separate from the driving axle; and (*d*) communicating motion from the armature shaft to the driving axle, substantially as hereinbefore described." He was of opinion that that claim was for a motor having all the four elements, which he had called *a*, *b*, *c*, *d*, in combination, each of them being "substantially as hereinbefore described." It had no reference to a spring suspension. It applied to a case where a car body had no truck, and where springs were not described. It also applied to a case where there was a truck, but where belts were used, and where springs would not be needed. The second claim was verbally identical with the first claim, except that the optional supporting springs were added—"supported partly or wholly by springs from the car body, carriage body, or truck." It followed that, in his view, this had no reference to the spring suspension. With reference to the third claim, there, for the first time, was mention made of what he (the Judge) called "spring suspension." He was asked to hold that the last claim was practically identical with the first claim. He was unable to do so. It seemed to him to be an essentially different claim; it added something which was not found in the first claim, and which he believed was intentionally omitted from that claim. His Lordship concluded:—This being the construction which I place upon the specification, it was faintly, if at all argued, that the patent could be supported. The first claim, as I read it, was plainly not new, and the action, therefore, fails. Had I adopted the plaintiffs' contention that spring suspension is to be found in the first claim, it would have been necessary for me to consider in detail several of the alleged anticipations. But, in the view which I take, I think it would be a waste of time to do so. Suffice it to say, that my opinion is adverse to the plaintiffs on this point also. The action must be dismissed with costs.

Mr. Cripps, Q.C. (for defendants) asked for a certificate that the particulars which had been referred to, with the exclusion of Garland's, were reasonable.

His Lordship replied in the affirmative. The shorthand notes would show what the particulars were.

Mr. Gray (for plaintiffs) asked his Lordship not to grant so general a certificate, on the ground that several of the specifications put in by the other side only related to small parts.

His Lordship said he could not see his way to give any such direction. He went on to say, in answer to Mr. Cripps, that he did not mean to charge the plaintiffs with anything more than one set of costs. He had treated the defendants as only one defendant.

Mr. Gray said his clients might think it desirable to take the matter further, but they were not desirous of staying execution if an undertaking were furnished as to the return of costs. Mr. Gray said he understood that the defendant company was at present in liquidation (Counsel on the other side: Not yet), and he, therefore, asked for the usual undertaking from the solicitors.

His Lordship said he could not impose terms. He had dismissed the action with costs.

Mr. A. J. Walter, on behalf of the third parties to the action, the British Thomson-Houston Company, Limited, makers of the article in dispute, put in an application that they should be allowed their separate costs up to a certain stage in the proceedings, but eventually withdrew the application, and said that his clients would agree to his Lordship's ruling that there should be only one set of costs.

Heyl-Dia *v.* Edmunds and Others.

In the Chancery Division of the High Court of Justice on Saturday, November 11th, before Mr. Justice Kekewich, the hearing was concluded of an action brought by George Edwd. Heyl-Dia, an electrical engineer and chemist, carrying on business in Manchester, against the defendants, Henry Edmunds, of Victoria Street, Westminster, Jas. Edgar Baxter, of Highfield Leyland, rubber manufacturer, and M. G. B. Samuelson, managing director of Messrs. W. G. Glover & Co., of Salford. Plaintiff sought to obtain a declaration that he was entitled to the benefit of an invention and secret process for recovering from India-rubber waste a commercial India-rubber which was suitable for various purposes, and which he called "Heyloid." Plaintiff also sought an injunction to restrain the defendants from in any way disclosing particulars of his invention and secret process. Mr. Heyl-Dia also asked, alternatively, that it might be declared that he and the defendants, or some of them, were partners with regard to the invention and secret process; and, further, for a dissolution of partnership, with the usual inquiries and accounts. Defendants, by their statement of defence, admitted that plaintiff invented the secret process, but denied that he was the sole proprietor. It was said that the plaintiff had disclosed to all the defendants the mode of carrying out his invention, and the defendants affirmed that he was bound to do so under the terms of an agreement with them. For the purpose of testing the invention, the defendant, Baxter, had expended a large amount of money in the erection of works at Leyland. As to the defendant Samuelson, it was said that he had subsequently made an arrangement with the defendant Edmunds, whereby all his interest in the invention became Edmunds's property. As Baxter had spent a larger sum of money than was contemplated, a re-arrangement of the shares was effected under which Edmunds and Baxter would be each entitled to one-third. The three parties proceeded to form a company for the purpose of taking over and working the process. On July 12th, 1898, a company called the Caout-Chouc Company, was registered for that purpose. Shortly after registration, viz., on August 3rd, an agreement was made between Edmunds and Baxter and the plaintiff, but for the defence it was said that that had been rescinded, and defendants claimed that they, equally with the plaintiff, would be entitled to the use of the secret process and invention. The statement of defence further set out that the defendant Samuelson, did not now claim to be interested in the invention and secret process.

In the result, and after hearing evidence, his Lordship held that although there was no partnership between Baxter, Edmunds, and the plaintiff, Baxter and Edmunds were entitled to the benefit of the invention. If they were all co-owners, the plaintiff was entitled to one-third share under the new arrangement made between himself, Baxter, and Edmunds. Looking at the whole of the evidence, his Lordship thought plaintiff was entitled to no relief against the defendants, and there would simply be judgment for the defendants with costs.

Counsel for the defendants, on the suggestion of his Lordship, said they gave an undertaking not to disclose the secret process of manufacture of Heyloid, pending a possible appeal.

The British Insulated Wire Company *v.* The Dublin United Tramway Company and The National Conduit and Cable Company, of New York.

On 8th inst. this case was listed for hearing before the Vice-Chancellor, at Dublin. The action was one for damages for alleged infringement of a patent, and the only order which his Lordship was asked to make was one for an inquiry as to damages.

The Solicitor-General, Q.C., M.P., Mr. C. L. Matheson, Q.C., Mr. Blood, and Mr. Gerald Fitzgibbon (instructed by Messrs. D. & T. Fitzgerald) appeared for the plaintiffs; and the defendant companies were represented by Mr. Stephen Ronan, Q.C., Mr. J. Gordon, Q.C., and Mr. Fitzgerald Murphy (instructed by Messrs. Casey & Clay).

The Solicitor-General, in opening the case for the plaintiffs, said the writ was issued on September 10th, and originally claimed an injunction as to two patents, 11,894 of September 2nd, 1884, and No. 13,340, of October 19th, 1886. The latter patent had now dropped out of the case, and the Court was now solely concerned with patent No. 11,894. An injunction in the case would involve the taking up of all cables in the tramway system in Dublin, but as damages would meet the case, the plaintiffs only asked for an inquiry as to damages.

Mr. Ronan: Yes; out of mercy to us, the injunction is not asked for.

The Solicitor-General: Not to you, but partly out of mercy to the citizens of Dublin. The patent was a patent for an improvement in the insulation of electric conductors or cables. It consisted in applying to the electrified conductor some non-conducting material which is placed around it, and which protects the electrified cable from waste of electricity and from all surrounding substances.

Mr. Ronan, Q.C.: It is not necessary to go into all this. We admit the cable laid down is in substance made according to the principle of the plaintiffs' cable. If the Solicitor-General told your Lordship the patent expired on September 2nd last, before the writ was issued, it would have thrown a little more light on the matter.

The Solicitor-General: The infringement is admitted by affidavits, and it is quite obvious there must be an inquiry as to damages.

Mr. Ronan: There is some infringement, unquestionably.

Mr. Matheson: If you admit it now it is only a question of account.

The Solicitor-General said the invention consisted in the discovery that Manila paper—a pure vegetable paper—formed the best insulator.

Mr. Ronan, Q.C., said the patent was only a 14-year one, and they admitted using the invention.

Mr. Matheson, Q.C., said the plaintiffs had put in a tender for £30,092, and the tramway company had given the contract to the other defendants, so that a big amount was involved, and there should be an account.

The Solicitor-General said in any case he desired to state the plaintiffs' case. The British Insulated Company, who carried on business at Prescot, received a letter on October 18th, 1897, from the tramway company, asking them to tender for the piping and cables for the tram system of Dublin, the tenders to be lodged before November 1st. The date of sending in tenders was subsequently postponed to November 15th, and on the 13th plaintiffs sent in a tender, and the measure of damages would be the profit the plaintiffs would have made in the contract, because they were the only people in the United Kingdom empowered to legally sell that cable.

The Vice-Chancellor: Do you dispute that measure of damages, Mr. Ronan?

Mr. Ronan, Q.C.: Entirely. I say the only damage they can recover in respect of the patent is for user, but they cannot recover for any act done outside the jurisdiction.

The Vice-Chancellor: What do you mean by outside jurisdiction?

Mr. Ronan, Q.C.: For instance, there might be people making it in America. The point is, what acts have been done within the jurisdiction? I may tell you the patent expired on September 2nd, and we should have been at perfect liberty to send our goods into Ireland and the tramway company to take them on September 3rd, and the mistake we made is that we sent them a few weeks before, and for that mistake we must pay.

The Solicitor-General said the amount of the plaintiffs' tender was £30,092 12s. 10d., and afterwards they got information that cables were being delivered in Dublin, which were an infringement of their patent, and they sent a representative, Mr. Guiseppi, in August, 1898, to Dublin, and he saw the cables in the streets, and being delivered from the ships from America. He took samples, which showed the cables were identical with the plaintiffs' patent. The expiring years and months of a patent were most valuable, and had the plaintiffs got the contract a large profit would have been made. The statement of claim was delivered on September 9th, limited to the patent of 1884. It stated that the plaintiffs were the owners of the patent up to September 2nd, 1898, and that while the letters patent were good and valid the defendants infringed the patent. The American company occupied a similar position in America to the British Insulated Company here, and the tramway company preferred to get their goods from the American company. Down to September 2nd the plaintiffs were sole proprietors of the patent, and gave no license to anyone in the United Kingdom to sell their cables. The defendants deliberately took the risk, and now they had to face the music, and the only question was what were they to pay.

Mr. Tracey, secretary of the plaintiffs' company, was then examined, and stated that, had his company got the contract, they would have had a profit on the cables of £2,735.

Mr. Gordon, Q.C., said the damages would be limited to the amount of cable delivered up to September 2nd. It was a very small portion.

Evidence was also given as to the laying down of the American cables in Dublin.

Mr. Ronan, Q.C., in opening the case for the two defendant companies, said the patent of 1884 expired eight days before the commencement of the action, and therefore the action as far as it claimed an injunction to restrain the defendants was all nonsense. The result of the earlier proceedings was that the patent of 1886 was dropped altogether, and afterwards the injunction as to the patent of 1884 was also dropped. He submitted that the interlocutory motion should be refused with costs. The only question now was the amount of damages they should pay for the infringement of the patent of 1884, and what profit the plaintiffs would have made out of the cables supplied before September 2nd.

The arguments having been concluded,

The Vice-Chancellor said that the plaintiffs were not entitled to seek for an injunction, and he directed an inquiry as to damages, the inquiry to be limited to that portion of the cable received by the Tramway Company prior to September 2nd, plaintiffs to have general costs of the action, save the costs of the injunction, which were given to the defendants.—*Irish Times.*

In re The London Electrical Cab Company, Limited.

In the Chancery Division of the High Court of Justice on Saturday last, Mr. Justice Byrne had before him the matter of Bersey *v.* the London Electrical Cab Company, Limited, which was a motion on behalf of the plaintiff in a debenture holder's action to which no defence had been put in. Mr. Bersey, the plaintiff, it appeared was the holder of certain first mortgage debentures, which charged the whole undertaking of the defendant company, and the principal moneys became payable if a distress was put in, an execution levied, or if the company ceased to carry on business. The defendant company was said to have lost £11,000 in two years, and in consequence of it having ceased to carry on business, and a distress having been put in for rates, the debentures had fallen due. His Lordship made a declaration that the debentures formed a charge upon the undertaking of the company, and pronounced judgment in the ordinary form in a debenture holder's action, with liberty to apply in Chambers for a sale of the undertaking as a going concern.

Madras Electric Tramways Company, Limited.

On Wednesday, the 10th inst., in the Chancery Division of the High Court of Justice, the petition of the Electric Construction Company, Limited, for the winding up of the Madras Electric Tramways Company, Limited, was heard. Mr. Herbert Reed, Q.C., who appeared for the company, said that a fortnight ago he asked that the matter should stand over, but he felt that he could not now ask for further indulgence in that respect. There were a number of native shareholders, and there seemed to be some difficulty about the matter. Under those circumstances, counsel for the company asked for a compulsory order. His Lordship granted the compulsory order sought for.

In re Milver Portable Electric Battery Syndicate, Limited.

In the Chancery Division of the High Court of Justice on Wednesday, November 15th, Mr. Justice Wright, sitting as an additional judge for the transaction of company winding-up business, had before him the petition of G. Trenam for the winding up of the Milver Portable Electric Battery Syndicate, Limited. Mr. Claire said this was a winding-up petition by a creditor. There was some difficulty about it, as his Lordship would notice that the name of the company as it appeared in the *Gazette*, was that of the "Milner Portable Electrical Battery Syndicate, Limited," instead of "Milver, &c." In a Birmingham paper, however, the name of the company appeared correctly in the advertisement. The company had approached the petitioner with a view to paying him off, and counsel therefore hoped that the matter would stand over for a fortnight.

His Lordship acceded to counsel's request.

BUSINESS NOTICES, &c.

Electrical Wares Exported.

Week ending Nov 15th, 1898		Week ending Nov. 14th, 1899.	
Alexandria	Value £120	Alexandria	Value £736
Amsterdam	210	Amsterdam	901
Boca	37	Antwerp. Elec. fuses	204
Boulogne	39	Bangkok. Teleg. mat.	95
Brisbane	40	Bergen. Teleg. cable.	10,475
Brussels	110	Boulogne	65
Calcutta	111	Brisbane	133
Canterbury	24	Buenos Ayres. Teleg. mat.	10
Cape Town	1,534	Calcutta	146
Christiania	15	Cape Town	468
Colombo	33	Christchurch	17
Copenhagen	70	Christiania. Teleg. wire	68
Demerara	25	Colombo	35
Durban	97	Durban	95
Flushing	10	Gibraltar	20
Fremantle	624	Gothenburg. Teleg. wire	12
Hamburg	120	Hamburg. Teleg. mat.	440
Hong Kong	1,757	Hong Kong	58
Las Palmas. Teleph. mat.	15	Kobe. Teleg. cable	145
Madeira	12	Launceston. Elec. motor	113
Melbourne	143	Lyttelton	24
Ostend	30	Madeira	13
Perth	38	Marseilles	69
Rio de Janeiro. Teleg. mat.	18	Melbourne	123
St. Petersburg	256	" Teleg. wire	974
" Teleg. mat.	180	Monte Video	100
Santander	20	Ostend	221
Santos	68	Perth	534
Sydney	2,461	Piraeus	15
Trinidad	26	Port Elizabeth	279
Wellington	361	Port Said	23
Yokohama	1,190	Santander	108
		St. Petersburg. Teleg. mat.	33
		Shanghai	12
		Stockholm. Teleg. mat.	143
		Sydney	186
		Wellington	448
		" Teleph. mat.	860
		Yokohama	1,096
		" Teleg. mat.	244
		" Telephones	360
Total	£9,874	Total	£20,464

Foreign Goods Transhipped.

Adelaide. Teleph. mat.	Value	£111
Cape Town. Telephones		113
Total		£224

"All work and no play, &c."—London is by no means prepossessing in the late autumn or winter season, and the desire to avoid its dampness, dreariness and fogginess warrants no rebuke. The man whose very life is bound up in mere mundane matters may break his bonds asunder and escape for a few hours to spend a week-end far from the madding crowd. As a director of or shareholder in electricity supply concerns, he may glory in a really good dense and prolonged London fog, but as an ordinary individual he clamours for pure air. The combined influences of a mind at rest and of the breezes of fresh fields and pastures new, minus fog, revive his drooping spirits so that he returns to duty the better equipped for thorough hard work. The *South Coast Quarterly* for November carries one in thought to the neighbourhoods of Brighton, Tunbridge Wells, Arundel, and so on, and by the aid of neat little views places before us the leading attractions that these places offer for either brief or prolonged visits, at this period of the year. Some notes on the various associations of these picturesque and health-giving resorts are contributed in an entertaining manner by Joseph Hatton and other writers.

Appointment Vacant. — The East Indian Railway Company, 28—30, Nicholas Lane, E.C., is inviting applications for the post of electrician to advise on, and superintend, the erection and working of electrical plant for power and lighting in India. Age 28—35; salary, 800 rupees a month. Applications, with testimonials and medical certificate of fitness for service in India, to be addressed to the Secretary by November 22nd.

Auction Sale. — On Tuesday next, 21st inst., Messrs. Wheatley Kirk, Price & Co. will sell by public auction the contents of the Globe Works, Kirkstall Road, Leeds, by order of the trustee in *re* J. A. Edmondson, electrical engineer. The plant comprises an electrical installation for 10 arc and 20 incandescent lamps, several engines, motors, lathes, planing, boring and other machines. The new stock to be offered also comprises dynamos, motors, and stores, &c.

Bankruptcy Proceedings. — The first meeting of creditors in *re* E. M. Winter, electrical engineer, Amberley House, Norfolk Street, London, will be held on November 17th, and the public examination on December 19th, both at Bankruptcy Buildings, Carey Street, W.C.

Books Received.—"Fire Tests with Partitions," by Messrs. D. Anderson & Sons, Limited, and Messrs. J. C. Broadbent and Co., Limited. London, 1899: British Fire Prevention Committee. 2s. 6d.

"Leçons sur l'Electricité, professé s a l'Institut Electrotechnique Montefiore annexé a l'Université de Liége," par Eric Gerard, Tome second; sixième édition. Paris: Gauthier-Villars et Fils, 1900. 12 fr.

Catalogues and Lists.—The Whitney Electrical Instrument Company, of America, sends us a proof sheet of its voltmeters, ammeters, and ohmmeters, portable and switchboard, for direct and alternating current.

The British Thomson-Houston Company sends us one of its No 47 illustrated pamphlets of slow and moderate speed motors (C E type). The construction and various parts are explained, and illustrations showing the motors applied in printing work appear.

Messrs. Bradbury & Co., Limited, of Oldham, have issued an illustrated list of their Capstan lathes. Their new No. 6 Capstan lathe, has been designed specially for electrical engineers, for the rapid and cheap manufacture of incandescent lampholder parts. Electricians and manufacturers of lampholders have frequently expressed to them a desire for a lathe lighter in construction than the ordinary Capstan, and one which will take up to 1¼ inches in diameter through the spindle with automatic wire-feed and grip motion. It is considered that the machines used for this class of work are generally much heavier than is necessary and are not as convenient to operate, and it is claimed will not produce the work as rapidly as the No. 6 Capstan. To produce work from hollow castings, tubes, &c., it is necessary to have Bradbury's patent expanding chuck for holding same. When working from rods or solid castings an ordinary spring cone chuck is used; both are supplied with this lathe. Although the No. 6 lathe will take up to 1¼ inches through the automatic wire-feed and will produce an infinite variety of articles from brass, it will not do work from iron or steel larger than can be executed on their No. 5 Capstan, which only passes up to ⅝ inch through the wire-feed. It is essentially a brass-working machine.

Messrs. E. Goossens, Pope & Co., of Basinghall Street, E.C., are sending out circulars of their newest types in high voltage lamps. The obscuring of all lamps is effected by means of sand blast which does away with the discoloration found in many lamps frosted by chemical means.

A 16 pp. pamphlet has been issued by the Electrical Transmission Company, Limited, of Hammersmith, giving some general information and illustrations showing "progress in the electrical transmission of power." The matter is reprinted from an interestingly written article by Mr. W. F. Jones, A.M.I E E., M.I.Min.E, in a recent issue of the *Engineering Times*. The illustrations show a number of the applications of electric motors to factory driving, mining work, &c.

Charge of Stealing Electricity.—At West London, Mr. W. A. Webb applied on behalf of the Hammersmith Vestry for a summons against a person for stealing electricity. He stated that the complaint was that a connection was made at the side of the main wire belonging to the Vestry, with a fraudulent intention. A summons was granted.

Colliery Equipment. — The lighting of coal mines by means of the electric light is rapidly growing in favour in the North of England, and our Sunderland correspondent has just learned from Messrs. Reid, Ferens & Co., of Sunderland and Newcastle, that they have several important works of that character in hand. The contracts include the supplying and fixing of two steam engines and two 220-volt, 100-ampere dynamos, complete with massive slate switchboard, and wiring for 200 lights for the Weardale Coal and Iron Company's Thornley Colliery; also one steam engine and dynamo for 220 volts, complete, for the Marquis of Londonderry's new Dawdon Colliery; also the supply and fixing of the necessary engines and dynamos, wiring, &c., for the South Moor Coal Company's several pits and villages, as well as the making and maintenance of the "Sussman" patent miner's lamp in use at the colleries. The firm have also just concluded the lighting of the colliery village of Deaf Hill, Durham. In addition to these important contracts, the firm named has had a lot of smaller work, one item being the lighting of the whole of the finished premises which have been erectrd in place of those destroyed by last year's fire at Sunderland.

Electrical Engineering in Italy.—A meeting has just been held at Padua to consider a scheme to utilise the water-power of the Piave and Cellina streams in the generation of electrical energy and the distribution of the same in Venice for lighting and power purposes. It was decided to proceed with a scheme, and a company is to be formed for the purpose.

For Sale.—From an advertisement in this issue it will be seen that the electrical plant, lease, &c., of the electrical engineering business now carried on by Messrs. Heath, Snoxell & Co., Limited, Birmingham, (in liquidation) is offered for sale at £3,750 or valuation.

Messrs. Fuller, Horsey, Sons & Cassell will, on 30th inst., sell by auction engineers' tools and stock on the premises of the Maskelyne British Typewriter Company. See our advertisment pages for particulars.

Honour and Glory!—*Indian Engineering* says that the American contractors, "who supplied the Atbara Bridge, lose largely by the transaction. But the honour and glory count for a great deal!" There is no doubt that the affair has been a splendid advertisement for American contractors, but if it has served the purpose of arousing English firms to the importance of being better prepared to meet competition, it has not been altogether a disaster to English industry.

Intended Dividend.—The last day for receiving proofs of the intended dividend in *re* E. B. Pym, electrical engineer, Scarborough, is November 29th. The trustee is Mr. A. H. Wildy, Bankruptcy Buildings.

Liquidations, Dissolutions, &c.—Messrs. W. O. Rooper and A. G. Robins (W. O. Rooper & Robins, electrical engineers, Victoria Road, Stafford), have dissolved partnership. Mr. Rooper will attend to debts and will continue to trade at the same address.

A meeting of Berry's Electrical Company is to be held at the offices of Rowlands & Co., 41, Temple Row, Birmingham, on December 21st to hear an account of the winding up from the liquidator, Mr. A. E. Chatterley.

Mr. F. B. Nicholson informs us that the partnership existing between Mr. R. G. Tyler and himself has ceased to exist, and that he will in future carry on business at 53, Victoria Street, Westminster, in the name of Nicholson & Co. Mr. R. G. Tyler, we understand, has made arrangements to take into partnership Mr. W. Duncan, A.I.E.E. late chief of the electrical engineering staff of Messrs. Laing, Wharton and Down, Limited. The business of electrical and mechanical engineering and also that of Messrs Ernest Scott & Mountain, Limited, in London and district, will be continued at the same address, 20, New Bridge Street, E.C., by the new firm under the style of Tyler & Duncan. Special attention will be devoted to Messrs. Scott & Mountain's manufactures.

New Exhaust Pipe Head.—One of the most objectionable phenomena incidental to the use of an atmospheric exhaust pipe is the constant spraying with a mixture of oil and water, to which the surroundings are subjected. This may even lead, as in the case of the Westminster Electricity Supply Company, to legal proceedings for an abatement of the nuisance; it is not due to condensation of the exhaust steam itself, but to the moisture suspended in the steam, and is therefore capable of being avoided. A form of exhaust

head, recently described in the *American Electrician*, is made by the B. F. Sturtevant Company, Boston, and is intended to catch all suspended oil and water while permitting easy escape of the steam. The exhaust pipe is surmounted by a funnel, as seen in the figure, within which the pipe is divided; the two branches discharge the steam tangentially close to the outer walls, and give it a vigorous whirling motion. The entrained water and oil, thanks to their high specific gravity, which is 1,600 times greater than that of the steam, are thrown outwards, trickle down the sides of the funnel, and are led away from an outlet at the bottom, while the dry steam escapes freely through the central opening. These heads are made in sizes from 1 inch to 20 inches diameter.

Revolving Shade Lamp.—The Edison & Swan United Company has issued a leaflet describing the "Comet" revolving shade lamp, which consists of an enamelled or plated cylinder which revolves in a wire cradle, enabling the light to be thrown in any direction. It is well known that the impact of a direct ray of light upon the eye leads to injurious results, in consequence of the constant efforts of the muscles of accommodation of the eye to ward off harmful excess. The eye-shade, which serves as a reflector as well, may be moved by a touch to any desired angle, so that a desk, table, or other desired object alone may be illuminated, and all sharp shadows prevented. The standards are adjustable, are made in polished oak and also in metal. The cylinder or hood containing the lamp is white enamelled inside and green enamelled outside, but can be supplied nickel plated. The list illustrates the lamp adapted for desk, surgical, orchestral and other uses.

The Stanley Show. — Messrs. W. Canning & Co., of Birmingham, are again exhibiting their electro-plating plant and appliances at the Stanley Show at Stand 49, Machinery Section.

Trade Announcement.—Messrs. Oliver & Co., arc lamp manufacturers, announce that they have been obliged to take larger works owing to increased business. Their address is now Cambridge Place, Burrage Road, Woolwich. They have recently received an order from the Charing Cross and Strand Electricity Supply Company, Limited, for arc lamps and accessories required by the St. Martin's Vestry for lighting the Strand and Trafalgar Square, &c; They also have large orders in hand for the Great Northern Railway, Sir W. G. Armstrong, Whitworth & Co., Limited, of Manchester, and the Birmingham Carriage & Wagon Company (per Messrs. Ellis and Ward, Birmingham) &c.

ELECTRIC LIGHTING NOTES.

Aycliffe.—The Darlington District Council has agreed to the erection of an overhead line along the side of the highway, to carry the electric current to the village of Aycliffe, over a distance of half a mile. The example of Aycliffe might well be followed by other villages.

Barnet.—The District Council has resolved to obtain a new provisional order covering the whole of the Council's district.

Barnsley.—An inquiry was held last week by Colonel W. Langton Coke, M.I.C.E., an inspector of the Local Government Board, relative to an application of the Town Council to borrow £3,661 for the purpose of installing the electric light in various public buildings.

Berwick.—The Sanitary Authority, acting on Mr. Campbell Swinton's advice, has decided to support Edmundson's Electricity Supply Company, Limited, in their application for a provisional order.

Brecon.—According to the *South Wales Daily News*, Col. J. Morgan, J.P., Mayor of Brecon, has undertaken to defray the whole cost, estimated at £6,000, of establishing an electricity works in Brecon, and has instructed Mr. Bertram Thomas, of Manchester, to prepare a scheme. A provisional order is to be obtained at once.

Cleckheaton.—The District Council has decided to apply for a provisional order to supply electricity for public and private purposes within the district.

Clydach.—This rapidly rising town in the Swansea Valley showed itself in festive mood on Thursday evening last week, jubilant in the fact that it had shown the way in town-lighting matters to all rival towns—even Swansea itself. A public dinner was held in the Town Hall to inaugurate this lighting scheme, of which a short description may interest our readers. Some months ago the District Council let the contract for electric lighting of the streets to Messrs. John Player & Co., who had already a large power and lighting plant for the supply of their tinplate works and tinplate rolls foundry (from which some of the finest tinplate rolls to be had in this country are turned out). Mr. Player then selected the well-known firm of contractors, J. C. Howell, Limited, to prepare a scheme for him, and they, having gone carefully into the matter, found that two parts of the township—Clydach and Aber-Clydach—were admirably adapted to the ring main system, the generating works being quite at one end of the town, in Aber-Clydach, and the greatest number of lights at the furthest point from the generating house; the third circuit—to Buildings Village—is a straight run of 880 yards, and offered more obstacles to constant pressure than the other two circuits. In order to get the voltage correct, the feeders were run, the positive out to the far end, a distance of 1,000 yards, the negative feeding in at the near end, a distance of 120 yards. The voltage at Mr. Player's works is 220, and the pressure on the lighting system is 200 volts, a loss of 20 volts throughout the entire system. The two ring mains consist of No. 12 bare copper, one of these being 1,760 yards round, and the other 1,000. The smaller ring is for Aber-Clydach, and the centre of distribution is only 350 yards distant from the generating house; the mains for this circuit to the centre of distribution are a pair of No. 9 bare copper, the feeders from this centre to the ring main being three pairs of No. 10 bare copper. On this circuit the current is 11 amperes, and there are 17 lamp brackets. The larger ring main is for Clydach, and for this the centre of distribution is 900 yards distant from the generating house; the mains for this circuit to the centre of distribution are a pair of No. 4 bare copper, the feeders from the centre to the ring main being three pairs of No. 8 bare copper; the current on this circuit is 16 amperes, and there are 27 lamp brackets. On the Buildings circuit the current is 6 amperes, and there are 10 brackets. The brackets are placed upon the poles which carry the overhead wires, and are of a very handsome design, and absolutely waterproof. Two 16-c.p. lamps are enclosed in each globe, with one exception, where two 32-c.p. lamps are placed on a bracket outside the Town Hall. The lamps hang downwards from a specially made ball fitting, and the whole globe is covered by a large shade. The brackets are placed 14 feet 6 inches from the ground, and the lighting effect is all that could be desired. The means of bringing the wires down the pole is, we think, a novel one. Before the bracket is fixed on the pole, a hole is bored through the pole running downwards from the bracket end, and the back plate of the bracket is let into the pole entirely, so making a watertight joint. A ½-inch pipe is then carried up the pole, the lower end being bent upwards to suit the run of the hole, the top end of the pipe is bent round in an 8-inch sweep, which just clears the arm carrying the wires on the top of the pole. The insulated wires then leave the pipe through an insulating bush, and are tapped on to the bare mains, a loop being left in them. The lower end of the pipe is now driven into the hole bored through the pole, and the pipe is then stapled to the pole, this protecting the wires, and making as waterproof a job as is possible when connecting from overhead wires. The whole of the work was designed and carried out by Mr. W. M. Furniss, chief engineer to Messrs. J. C. Howell, Limited. The scheme is of interest as one to be commended to many other small townships, which might with advantage follow the example of Clydach, granted that other owners of large works are to be found possessed of the public spirit and progressive policy of Mr John Player, to whom Clydach is indebted for an up-to-date illuminant at a very moderate cost; the rate is only ½d. in the £, as the cost per annum for each two 16-c.p. lamps is £3 5s.

Colchester.—The Town Council has decided to apply to the Local Government Board for leave to borrow from the Public Works Loan Commissioners, at 2¾ per cent. interest, the £6,590 sanctioned for further purposes of electric lighting.

Dawlish.—The District Council decided last week to apply for a provisional order for establishing an electricity supply. Messrs. Taylor & Field, electrical engineers, reported that the cost of an installation, with a capacity of from 1,350 to 1,330 8-c.p. lamps would be £4,350, exclusive of the site.

A public meeting of the ratepayers held subsequently approved by a large majority the decision of the District Council.

Farnham.—The District Council has resolved that application be made to the Board of Trade for a provisional order enabling the Council to supply within the district electricity for all public or private purposes.

Grove Park.—The Greenwich Board of Guardians has decided to adopt electric lighting for the new workhouse at Grove Park.

Hampstead.—The receipts of the Vestry's electric lighting undertaking for the quarter ended at Michaelmas were £5,737 4s. 1d., as against £3,638 4s. 1d. for the corresponding quarter last year, showing an increase of 58 per cent. The net profit on the undertaking last year was 6·65 per cent.

Horsham.—The District Council has adopted the recommendation of the Electric Lighting Committee to proceed to exercise the powers conferred by their provisional order, and that Mr. Hawtayne be instructed to prepare detailed drawings and specifications in connection with his scheme to enable the Council to make application to the Local Government Board for the necessary borrowing powers for an installation of the electric light.

Heckmondwike.—Colonel W. R. Slack, R.E., one of the Local Government Board inspectors, held an inquiry on Thursday, respecting the Council's application for sanction to borrow £14,000 for electric lighting purposes.

Hull.—An accident in connection with the electricity mains occurred in Waterworks Street last week. A strong smell of burning rubber having been noticed, the electrical engineer had the pavement opened, when a dense yellow smoke escaped, followed by a loud report and a flame. The fire increased so much that the chemical engine from the fire station had to be summoned to extinguish the flames.

Ingleton.—We are informed that the electric lighting of Ingleton, West Riding, Yorks, for which the Board of Trade granted a license, has been entrusted to Messrs. Drake & Gorham. The turbines will be supplied by Messrs. Gilbert Gilkes & Co., the mains by the Callender Company, and the storage battery by the D.P. Battery Company, Limited.

Kendal.—The Corporation registers its intention in the *London Gazette* to apply for a provisional order in the usual way.

Witney.—Notice of the Witney Electric Supply Company's application for a provisional order is filed in the *London Gazette*.

Kirkby Lonsdale.—The proposal of the Kirkby Lonsdale District Council to purchase the electric lighting plant of Mr. Harris, Lunefield, for £2,200, has been abandoned as too expensive for the Westmorland town.

Leeds.—The City Council has resolved to extend and renew the mains, and to construct transformer sub-stations in the Chapeltown and Clarendon Road districts, and at the Town Hall, at an estimated cost of £30,896. During September there were 30 breakdowns in the rubber-insulated cables; these are to be withdrawn, to the value of £6,500, and replaced by paper-insulated cables.

Leek.—The District Council has instructed Messrs. Burstall & Monkhouse, Westminster, to visit Leek and make a preliminary report on the proposed electricity works, for a fee of 30 guineas.

Littlehampton.—The District Council has decided not to consent to the application of Messrs. Lees & Co. for a provisional order for the electric lighting of Littlehampton.

Liverpool.—Colonel C. H. Luard, R.E., an inspector of the Local Government Board, will to-day hold an inquiry into an application of the Liverpool City Council for sanction to borrow £300,000 for the purpose of electric lighting.

London, E.C.—The *Times* contains an abstract of the annual report of Mr. A. A. Voysey, the electrical engineer and inspector to the Corporation, in which he states that 46 instruments, mostly meters, had been submitted to him for testing. Of these 19·35 per cent. were slow, 25·8 were fast, and 54·85 were approximately correct. The mean percentage in the slow meters was 5·3, and in the fast 7·6. The testing fees received amounted to £31 7s. 6d. The Board of Trade had recently approved of the Aron meter for use on the City alternating current circuits, and the inspector anticipated that the usefulness of the electrical testing laboratory would be greatly increased and it ought to be self-supporting. During the year, in the main streets, 502 arc lamps had been in use. The number of lamp failures reported had been 646. The

average time of extinction per lamp had been 220 minutes. Two hundred and forty-eight lamps had been late in starting—on an average 12 minutes. The penalties inflicted on the company for these failures had been £156. As to the side streets, the question of lighting had been delayed for another year in the endeavour to obtain a legal settlement of the differences between the Corporation and the company as to the meaning of the agreements for public lighting. There had been two interruptions in the private supply—one caused by the damage to a main by a pavement contractor. Serious defects in the pressure occurred on eight occasions and in circumstances which might not be repeated.

Long Eaton.—The District Council has resolved to obtain a provisional order for the supply of electricity in the district.

Malden and Coombe.—The District Council has been approached by the Kingston Corporation on the question of electricity supply, but has replied that it is not at present prepared to consider the matter.

Malton.—The District Council has consented to permit the Northern Counties Electric Supply Company to obtain a provisional order for the supply of electricity in the district. The company guarantees to light the streets at a cost 30 per cent. less than that now paid for gas. The initial outlay will be £10,000, which will be ultimately increased to £40,000. The Council will have the option of purchase after 10 years.

Newport.—The following appointments have been made:—Mains superintendent, Mr. A. J. Howard, of Tunbridge Wells; electrician, Mr. L. L. Foster, of Coventry.

Northfleet.—The District Council has rejected a proposal to apply for a provisional order for electric lighting.

Oldham.—The Corporation is applying to the Local Government Board for leave to borrow £36,000 for extensions of the electricity works and mains, according to Prof. Kennedy's recommendations.

Provisional Orders.—The *London Gazette* contains notice of the intention of the Elland, Exmouth, Cleethorpes-with-Thrunscoe, Sowerby Bridge, Gosport, and Alverstoke Local Councils for electric lighting provisional orders, also a notice by the Croydon Council of its intention to apply for powers to lease the tramways to the British Electric Traction Company.

Redditch.—The manager of the electric lighting works reports to the District Council that the scheme has paid its way in the first quarter of its working, and has left a balance in hand.

Redruth.—The Council has decided to support Edmundson's Electricity Supply Company, Limited, in their application to the Board of Trade for a provisional order, provided the clauses to be embodied in it are agreed to by the Council.

Rhyl.—As the result of a canvass made by the District Council it has been found that 19 out of every 20 tradesmen and 50 per cent. of private residents will take a supply of electricity.

Romford.—The District Council has decided to make application to the Board of Trade for a provisional order, empowering the Council to supply electricity in the district.

Russia.—La Compagnie Centrale d'Electricité de Moscou reports a profit of £9,306 for the past financial year, and is declaring a dividend of 5 per cent.

Sale.—The Board of Trade has agreed to postpone the question of the revocation of the lighting order of the District Council until June 30th, 1900.

Tiverton.—The Town Council, having been warned by the Board of Trade that its provisional order would shortly be revoked, has induced the Board to postpone its intention for a few months, and has obtained estimates of the cost of carrying out a scheme, as well as tenders from firms willing to take over the order.

Torquay.—The Electric Lighting Committee is willing to convert street gas lamps into electric lamps at a cost of £2 10s. a year. The Town Council has authorised the conversion of 160 lamps, and has placed the public lighting under the control of the above Committee.

Train Lighting.—The London and North-Western Railway Company have made arrangements to put on their line from Abergavenny to Merthyr 10 trains of new carriages, lighted by electricity, and fitted with special heating apparatus.

Walsall.—The Corporation has resolved to purchase an additional transformer at a cost of £558, and to put down a new substation, to cope with the increasing demand.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Aston.—The District Council has decided to promote a Bill in the next session of Parliament to enable them to work the tramways in the district belonging to the Birmingham and Aston Tramways Company, Limited, and the City of Birmingham Tramways, Company, Limited, when such tramways shall be purchased by the Council.

Belfast.—Last week the Corporation held a special meeting, extending over two days, to consider the proposed acquisition of the street tramways and the operation thereof electrically. The resolutions to that end passed last April by the Council in committee were confirmed, after a long debate, in the course of which the advantages and economy of electric traction were discussed. A committee is to confer with the company as to terms. The town clerk is to give the necessary notices for the promotion of a Bill in the next session of Parliament.

Bournemouth.—A local paper says that the British Electric Traction Company are making another attempt to introduce tramways in Bournemouth. Foiled in their applications to the Light Railway Commissioners, they now propose applying for an Act of Parliament.

Cheltenham.—The Light Railway Commissioners have issued their order for the construction of an electric tramway from Cheltenham to Cleeve Hill. Simultaneously with this announcement, the statutory notice is published of Mr. Nevins's application to the Light Railway Commissioners for powers for the construction of a continuation line through the town in place of that section of the line quashed by the Commissioners early in the present year.

Colombo.—The Municipal Council has granted its electrical adviser, Mr. Thomas Cockerill, two months' leave from November 1st to January 1st, and has authorised him while on leave to prepare a report on the latest electric tramway practice in England and Scotland.

Devonport.—The construction of the system of electric tramways which is to be undertaken by the Devonport and District Tramways Company was formally begun on Tuesday last week. Mr. W. J. Waycott, chairman of the Corporation Tramways Committee, cut the first sod in presence of a numerous company, and subsequently the event was celebrated by a luncheon. Mr. J. S. Raworth, chairman of the Devonport and District Tramways Company, and director of the British Electric Traction Company, presided, and among others present were Mr. E. Garcke, director of the Devonport Company, and managing director of the British Electric Traction Company, Messrs. F. W. Chanter, director, and E. Hopwood, secretary of the Devonport Company, C. H. Gadsby and C. Chadwell, engineers for the company, and A. Foulks, contractor for the construction of the line. Mr. Garcke said the construction of the line would be pushed on as rapidly as possible. The company meant to go in for cheap fares and frequent service, and the line would be doubled where possible, so as to increase the efficiency of the service.

Dublin.—On 6th inst. an electric car collided with one of the Tramway Company's repairing cars. The trolley pole of the former was broken and the horse of the latter thrown. The service was suspended for a time.

One day last week an electric car ran off the line and blocked traffic for a considerable time.

On 9th inst. the electric tramcars began running to Drumcondra.

Electric Traction in Paris.—Electric traction is just now occupying a great deal of attention in Paris. In the first place it is being asked whether the great Metropolitan line, extending from the Vincennes Gate to the Maillot Gate, will be finished and in working order by next year. This line has a total underground length of 11,600 metres, and 23 stations. A tunnel of 10,200 metres has already been constructed, and 21 stations are finished. It is certain that the constructional operations will be finished by February, 1900. The Creusot establishments will at once proceed with the electrical installation. The principal station will be at Bercy; the work is already being commenced there. A series of subterranean lines is also to be formed at Paris for various tramways which are to extend from the suburbs to the heart of Paris. The work is being proceeded with, but nothing is finished as yet. The Electricity Company of the Sector of the Left Bank, which obtained the concession for two tramway lines from Boulogne to Vincennes, and from Montreuil to Boulogne, has just given up this concession to the Left Bank Electrical Tramways Company in consideration of an indemnity of 910,000 francs. The Compagnie Générale de Traction, of Paris, recently made an offer to the Compagnie Générale des Omnibus, to transform all their ordinary tramway lines, 17 in number, into electrical tramways, asking them to pay, until 1910, at which date the concession ends, a certain sum per car-kilometre, a sum that would be less than the cost in 1898 of their mechanical traction cars. Notwithstanding this offer, the Compagnie Générale des Omnibus has not yet come to any decision on the matter. Electric traction is at present, therefore, at a standstill in Paris.

France.—It is proposed to convert the steam tramways at St. Etienne into electric lines.

Glasgow.—After the Board of Trade inspection of the Govanhill electric tramways on Tuesday last week, the Tramways Committee formally opened the line for public service. The reconstruction of the permanent way from Glasgow Cross to Govanhill has been carried out partly by the staff of the tramways department and partly by the contractor, Mr. Daniel Murray. The rails used weigh about 100 lbs. per yard, and are in 60-feet lengths. Steel tie bars, 5 feet apart, are used to keep the rails in gauge. Under the track there is a 6-inch bed of Portland cement concrete. The copper bonding of the rails is done by the staff of the department. The nest of

ducts through which the feeder cables and wires are drawn is in the centre of the track, usually termed the 4-foot way. The erection of the overhead equipment is in the hands of Messrs. Macartney, M'Elroy & Co. Except on the Albert Bridge, hardly any side poles have been used between Glasgow Cross and the head of Crown Street, the span wires being for the most part suspended by means of ornamental metal rosettes affixed to the buildings, in the same manner as in West Nile Street. This is considered a great improvement, and the intention is that the tramways department will carry out this plan in future when at all possible. The *Glasgow Herald* says that if the overhead construction throughout the city is no more obtrusive than it is in Crown Street, very few citizens will object to its appearance. Some time ago, the electric tramway from Springburn to Mitchell Street (2½ miles) was opened. On January 23rd last, the extension from Parliamentary Road to Glasgow Cross (¾ mile) was opened, and the Govanhill extension (about 1¾ miles) makes up the total length of electric tramways now opened to about 5 miles of double track. For some time the tramways department have been very busy building new electric cars at the Coplawhill car works. The number now in use is 47, and these have all been built by the department. The connection from Cathcart Road across to Coplawhill depôt being now electrically equipped, the department will find this connection with the car building and repairing shops of very great service, as hitherto the electric cars have had to be taken to and from the car works by horses.

The *Glasgow Evening News* says that an accident is reported to have occurred on the Springburn tramway route late on Saturday night, whereby three men were injured. It is stated that in Castle Street a telephone wire broke and fell across the electric trolley wire. The telephone wire thus became charged with electricity, and, while squirming about the street, it is said to have encircled two men, throwing them to the ground. A labourer rushed to the assistance of the two men, and by catching hold of the wire, is said to have received a shock. When interviewed, the tramway officials stated that they had a report of a telephone wire having broken and come in contact with the trolley wires, but they were not aware that anyone had been injured.

Holland.—It is reported that Messrs. Siemens & Halske, of Berlin, have secured a contract to construct an electric railway between Rotterdam, the Hague, and Scheveningen.

Houghton-le-Spring.—Last week an extraordinary special meeting was held to receive a deputation from the Electrical Tramways Company, Sunderland, represented by Mr. F. J. Trewhitt, and Mr. D. Balfour, jun., C.E., Houghton-le-Spring, who submitted plans as to the proposed operations in laying down an overhead electric tramway system for Houghton-le-Spring district, and requesting the Council to give the promoters their support in applying to the Local Government Board for necessary powers for a lease of 42 years. The Council decided to support the proposal.

Ilfracombe.—At last week's Council meeting a letter was read from the British Electric Traction Company as to the proposal to run electric trams from the Pier to the railway station. Mr. W. Pile said they were not in a position to deal with the matter, seeing they had made such little progress with the electric lighting of the town. The clerk was instructed to write the company accordingly.

Kinver.—An order has been made by the Light Railway Commissioners, and confirmed by the Board of Trade, authorising the construction of light railways, on a gauge of 3 feet 6 inches, from Stourbridge to Kinver, in the counties of Worcester and Stafford, by the British Electric Traction Company, Limited. Three years is fixed as the period within which the works are to be completed, but this term may be extended. Provision is also made for widening certain roads and bridges by the company during the construction of the lines.

The lines authorised are:—No. 1, 2 miles 4 furlongs 4·5 chains, commencing in Amblecote, opposite Fish Inn, at Coalbourne brook, passing along High Street, Woolaston, until it unites with the Bridgnorth Road, and thence proceeding along the latter road towards Enville, and terminating in the parish of Kinver, opposite the Stewponey and Foley Arms Hotel; No. 1A, 1·5 chains, commencing by a junction with No. 1 at its commencement and terminating by a junction with the existing tramway opposite the corner of Collis Street, Coalbourne brook; No. 1B, 1·25 chains, commencing by a junction with No. 1 at its commencement and terminating by a junction with the existing tramway at a point 40 yards to the south-east of the termination of No. 1A; and No. 2, 1 mile 4 furlongs 8·5 chains, commencing by a junction with the termination of Railway No. 1 and terminating in the parish of Kinver on the western side of the road leading from Kinver Bridge to High Street at a point 75 yards to the southward of the canal lock.

Lancaster.—On Thursday last week the Council held a special meeting, at which it was resolved to promote a Bill empowering them to acquire the undertaking of the Lancaster and District Tramways Company, Limited, to construct certain additional lines, to widen certain streets, &c. The full amount required for the scheme was stated by the Mayor as £70,000. The tramway construction would be carried out by degrees. There would be 10 miles altogether. It is proposed to adopt the overhead trolley system.

At the present time there is a four-mile horse tramway between Lancaster and Morecambe. An effort has been made by the Lancaster and Morecambe Councils to buy up the tramway, but the company have declined negotiations at present. However, a clause will be inserted in a Bill, which the Corporation will submit to Parliament next session, to allow the purchase. Meanwhile the Corporation have drawn up a scheme mentioned above.

Liverpool.—Last week an influential deputation of representatives of railway, waterway, and carting companies waited upon the Lord Mayor to protest against the introduction of electric tramways in certain busy streets, as they might hamper the trade of the port, and materially increase the risk of accident. The Lord Mayor said a good case had been made out, and it would receive every consideration.

Manchester.—On 10th inst. Sir F. Marindin and Mr. A. P. Trotter held an inquiry, at Manchester, on behalf of the Local Government Board, respecting the application of the Corporation to borrow £800,000 for tramway purposes. The chairman of the Tramways Committee of the City Council stated that one portion of the tramways system would be worked by Salford, another by Oldham, and another by Ashton-under-Lyne. The central portion, which would be under the control of Manchester, included the districts of Middleton, Failsworth, Droylesden, Audenshaw, Gorton, Denton, Levenshulme, and Heaton Norris and Stockport. They were also in negotiation with Withington, Moss Side, and Stretford. The amount of the money mentioned was not all that would be required, but included the cost of the reconstruction of the whole of the present track within the city boundary, the electrical equipment of the whole of the city track with the outside districts already entered into agreement with, the provision of 600 cars, the estimates for one car-shed to accommodate 252 cars, and the preliminary expenses already incurred. The track mileage, including recent extensions, was about 150 miles, of which nearly 100 miles were owned by the Manchester and local authorities.

Mr. C. H. Wordingham, city electrical engineer to the Corporation of Manchester, said that the overhead trolley system was the most suitable, and two systems were proposed to be used, one being the span wire construction with centre running trolley, and the other being the side running trolley, which was the best in appearance. The choice would depend upon the width of the street or the importance of a good appearance. The poles would be of equal strength, so that there would be no difficulty in altering from one system to another at very slight expense in case of necessity. It would be impracticable to construct any underground system for the reason of interference with the traffic, and the prohibitive cost, which would be out of proportion to the advantages to be gained. The streets of Manchester were undermined very largely by pipes and cellars, which often reached to the kerb stones of the footpaths, and therefore it would be difficult to fix poles in the most suitable places. On this account it was necessary to make a good allowance for contingencies. At the central station the current was at present distributed for lighting purposes, but there would be sufficient power for traction over a surrounding area of half a mile where the traffic was particularly heavy. It was proposed to erect a large station at Stuart Street, where power would be generated and transmitted to sub-stations both for lighting and traction. It was intended to place the sub-stations as nearly as possible a distance of a mile from each other. Witness gave his estimate for his portion of the work for the lines which would be worked by Manchester independent of the lines which would be worked by other authorities in conjunction with the Manchester system. The overhead equipment for 68 miles in the city and 17 miles in the outside districts at £1,300 a mile would cost £110,500, and £16,575 for contingencies would raise the total to £127,075. For the bonding of the rails he presented an estimate, with contingencies, of £22,925, bringing the total with the cost of the overhead equipment to £150,000.

Mr. Ernest J. Scown, permanent way engineer of the Tramways Department, stated that the amount estimated for the reconstruction of 68 miles of single track of the existing permanent way to make it suitable for electric traction would cost £250,000.

Mr. John Gibbons, architect, submitted the plans of proposed car shed in Queen's Road, which with the purchase of the land is to cost £90,000.

This concluded the inquiry.

On 7th inst. a meeting of owners and ratepayers consented to the promotion of the Manchester Corporation Tramways Act, 1900.

Manchester Underground Railway Scheme.—We gather from an article in the *Manchester Courier* that a movement is on foot for the construction of an electric underground railway (to cost £1,200,000) by inner and outer services, bringing into connection the various railway systems. It is stated that a Manchester firm of solicitors is engaged in completing the preliminary arrangements, and it is expected that ere long the plans will be deposited in Parliament. According to the plans, the permanent way will be contained in two iron or concrete tubes, at a depth of from 50 to 60 feet below the surface. The carriages are after the pattern of those on the Douglas to Laxey line, and charging stations are to be erected on convenient sites.

Mumbles.—It is stated that the British Electric Traction Company intend adding to the attractions of the Mumbles by erecting a winter garden at the shore end of the Mumbles Pier, which is now their property. If this report be correct, the company is to be congratulated upon its emulation of a kind of enterprise which has contributed so largely to the success of some electrical lines in America.

Preston.—In accordance with the recommendations of Messrs. Lacey, Clirehugh & Sillar, the Council have decided upon a 4-feet gauge for the proposed electric tramways, and have resolved to promote a Bill next session for the purpose of obtaining the necessary powers to construct and run tramways both in Preston and the neighbouring districts of Fulwood and Walton-le-Dale.

(*Continued on page* 807.)

ELECTRIC CRANES.

The rapidly extending use of electrical transmission of power in workshops has necessarily included the application of this agent to the driving of cranes, both movable and stationary. But even where no other machines are electrically operated, the advantages of electricity for crane driving, as compared with the old square shafts, rope drive, &c., are so marked, that in many instances it has been found good policy to employ it solely for this purpose. We commence this week

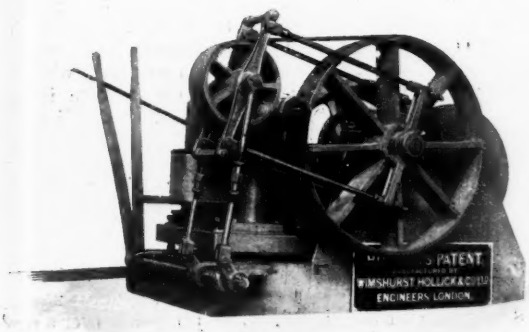


Fig. 1.

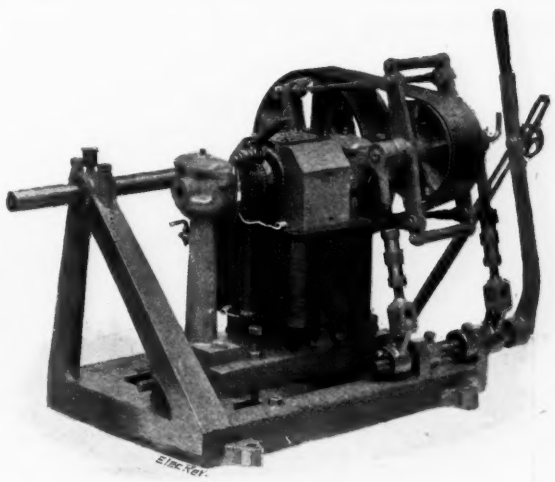
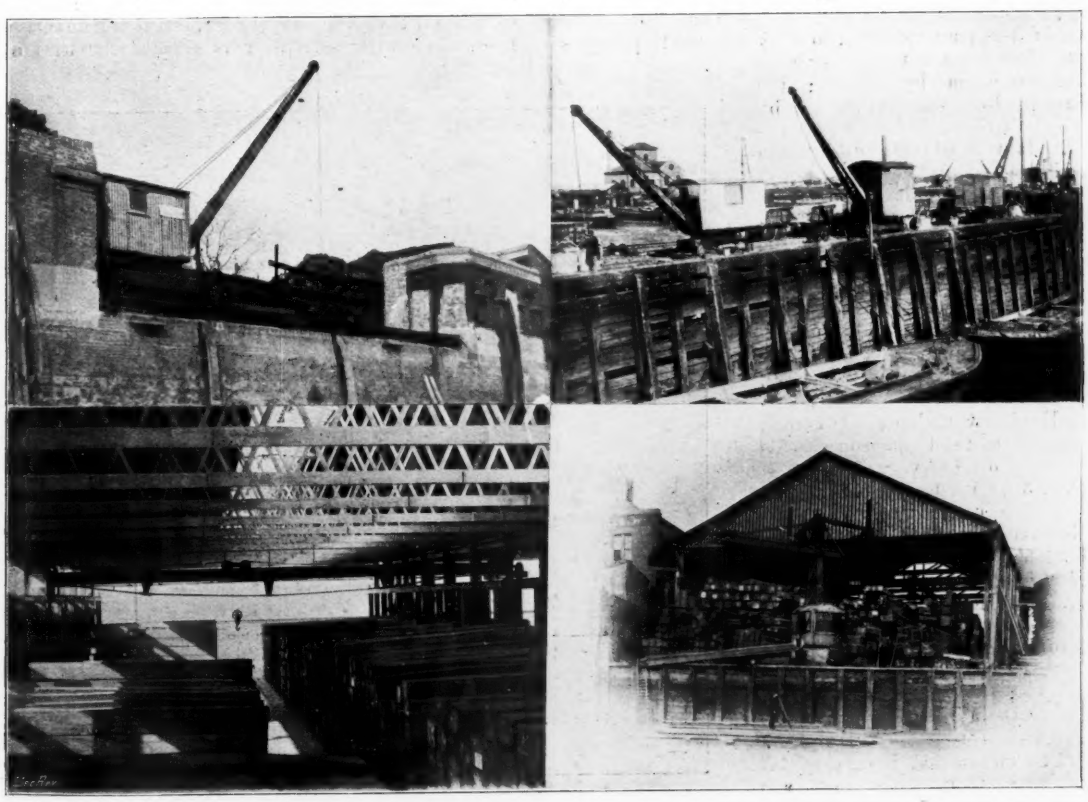


Fig. 2.

a series of views of cranes of both types which have actually been erected, showing the directions along which modern designs tend to proceed.

A. B.



C. Fig 3. D.

The high rotative speed at which electro-motors of small power must run in order to secure high efficiency with small initial cost, necessitates the interposition of a train of reduction gear between the motor and the main shaft, while the construction of the motor and its mode of working render a smooth and gradual start desirable. These requirements are met in various ways. The method employed by Messrs. Wimshurst, Hollick & Co., Limited, is illustrated in fig. 1, which shows the essential features of the system; the driven shaft is provided with a large "flat" faced pulley belted to a similar but smaller pulley, the latter being carried on a frame which swings on the main shaft. The tension of the belt can be adjusted by means of nuts on the side rods of the frame. The

armature shaft carries a small pulley made of compressed paper, the diameter of which is slightly greater than the least distance between the iron pulleys, and the motor itself is supported on a rocking base. When the motor has been started up by means of an ordinary starting resistance switch, the swinging frame is gradually brought down by means of the starting lever, so that the small pulley is wedged between the two larger ones and drives them by friction; the pressure on both sides is equalised by the slight rocking movement of the motor. It will be noticed that the motor is brought up to speed first, and may be kept running all the while the machine is in operation, without affecting the stopping, starting, &c., of the latter. A shunt motor must, of course, be used for this purpose. In case of jamming of the load, or an overload, the gear slips and prevents injury. Fig. 2 shows another view of the same gear, applied to a similar purpose. This gear is used on all Messrs. Wimshurst, Hollick & Co.'s electric cranes, and appears to fulfil the requirements mentioned above to a very high degree.

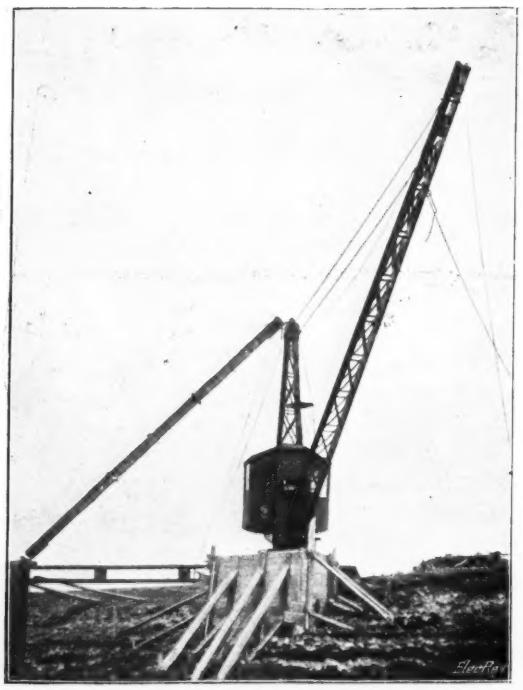


Fig. 4.

In fig. 3 we illustrate a few applications of these cranes. One which was installed at a coal wharf on the Thames in 1894, and is capable of lifting 25 cwt. 100 feet per minute, is shown in fig. 3A. The motor in this case took 2 amperes at 203 volts, running light; when lifting the full load at a speed of 80 feet per minute, the current was 21 amperes; for slewing with the load, 14 amperes was required; and for slewing while lifting the full load, 27 amperes. The current never exceeded 29 amperes, though the motor was capable of carrying 75 amperes intermittently. Fig. 3B. is a view of the jetty at Dagenham Dock, in Essex, on which are two electric cranes, employed in unloading barges at the rate of 1,000 tons each per week. The larger of these lifts 30 cwt. at 90 feet per minute, with a radius of action of 22 feet. Fig 3C shows an overhead traveller, of the fixed jenny type, in shed No. 4 of the West India Dock, where similar cranes have been at work since 1893; there are now 22 of these in use, with spans of 40 to 65 feet, lifting 6 tons at 15 feet, or 2 tons at 45 feet per minute, travelling longitudinally at 150 feet, and transversely at 65 feet per minute. These cranes require a maximum of 8½ H.P. when lifting the full load, and therefore have an overall efficiency of nearly 72 per cent. For travelling with full load about 3 H.P. is required. Fig. 3D is a view of a stationary jib crane, specially designed to utilise as much space as possible for stacking timber at a sawmill. The jib is horizontal, and is carried on a steel post pivoted at top and bottom; a bogie runs along the jib to carry the load at a radius variable from 5 to 20 feet. Three electric travellers are installed within the timber sheds. One of their greatest recommendations for such situations is the low insurance premium compared with that which would be demanded if steam cranes were in use. These cranes, and a timber stacking crane, are supplied with power by a dynamo of 24 E.H.P., which is driven from the main shafting; although the power required to drive the cranes would be over 30 H.P. if they were all working at once, it is found that the dynamo is of ample capacity to cope with the maximum demand met with in practice.

Fig. 4 represents a tall derrick crane capable of lifting a load of 2 tons at 50 feet per minute, 4 tons at 25 feet, or 8 tons with a return block. The jib works over a circle of 24 feet radius. Figs. 5 and 6 show an end view of the crane seen in fig. 3C, and front view of a crane of the travelling jenny type, also at the West India Dock.

All the above cranes are operated by means of the Hollick gear, some of them having been at work for as long as six years; although the arrangement may not at first sight strike one as likely to please the "engineering eye," the fact remains that it has given excellent results in practice, as regards both efficiency and maintenance.

Another form of gearing which has been extensively applied is that of Messrs. Carrick & Ritchie; in this case bevel friction wheels are employed, and it is noteworthy that here also compressed paper is adopted for the rubbing surfaces. It is stated that a perfect grip is obtained with this material, and that it gives complete satisfaction in every way. Fig. 10 shows the method of applying the gear to a single motor crane; a clutch driven by a feather slides

Fig. 5.

upon the motor shaft between two loose friction cones, either of which can be put in gear by sliding the clutch towards it. The cones are in contact with a bevel wheel of larger diameter, which is driven in either direction according to the position of the clutch. Fig. 7 shows the gearing of a derrick crane of fixed radius; made by Messrs. Carrick and Ritchie. Double helical gear is used for the first speed reduction, followed by plain toothed gear. The details explain themselves.

An overhead travelling crane, capable of lifting two tons is seen in fig. 8; all the gear is at one end, and the load is carried by a jenny running across the beams, and pulled to and fro by means of pitch chains. It will be noticed that most of the bearings are split, so that any shaft can be removed without dismantling the crane; this applies also to the rail wheel axles. The use of solid bearings — a very objectionable feature, often met with in cheap cranes— is thus avoided. Several of these cranes are at work and giving every satisfaction.

Fig. 9 shows an electric derrick of the most recent type, fitted with a "Lundell" motor; the cabin, which is rendered necessary by the very exposed situation in which the crane is at work, is partly removed to exhibit the gearing. The load is raised at a speed of 60 feet per minute, which is an unusually high rate for a derrick crane. In this case double reduction toothed gear is used for lifting, and worm gear for swinging.

A very neat little travelling crane for light loads is illustrated in fig. 10; this is mounted on a bogie, and is provided with travelling, slewing and lifting gear worked by one motor of Messrs. Thos. Parker's make. This crane was designed for lifting loads of 5 cwt. from a barge at a speed of 30 feet per minute, and carrying them along the wharf. Here the speed reduction is effected by means of worm gear running in oil. Wire rope is used for the lifting tackle, in accordance with Messrs. Carrick and Ritchie's usual custom, though chains are sometimes fitted for special purposes. It is stated that wire rope is quicker and

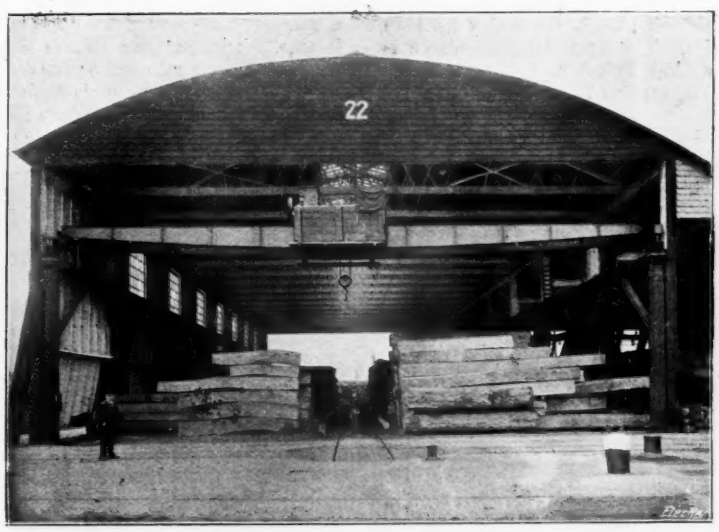


Fig. 6.

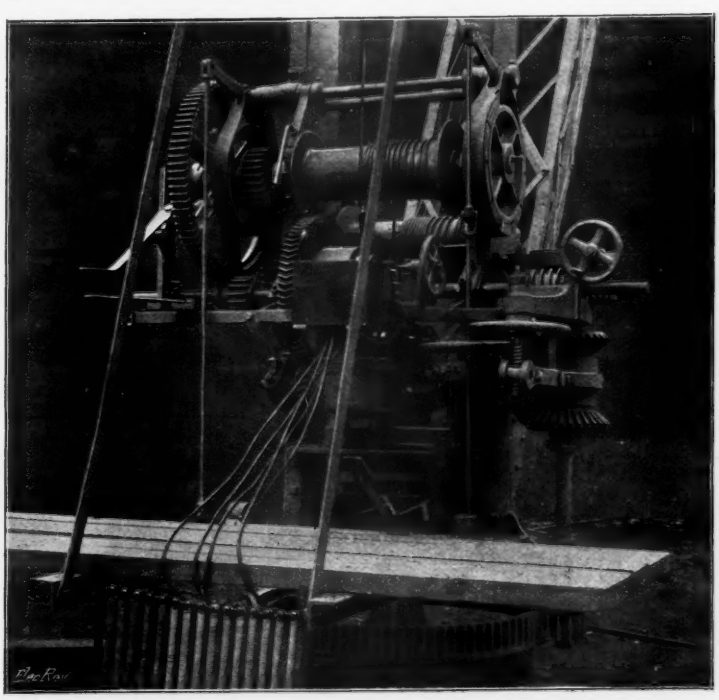


Fig. 7.

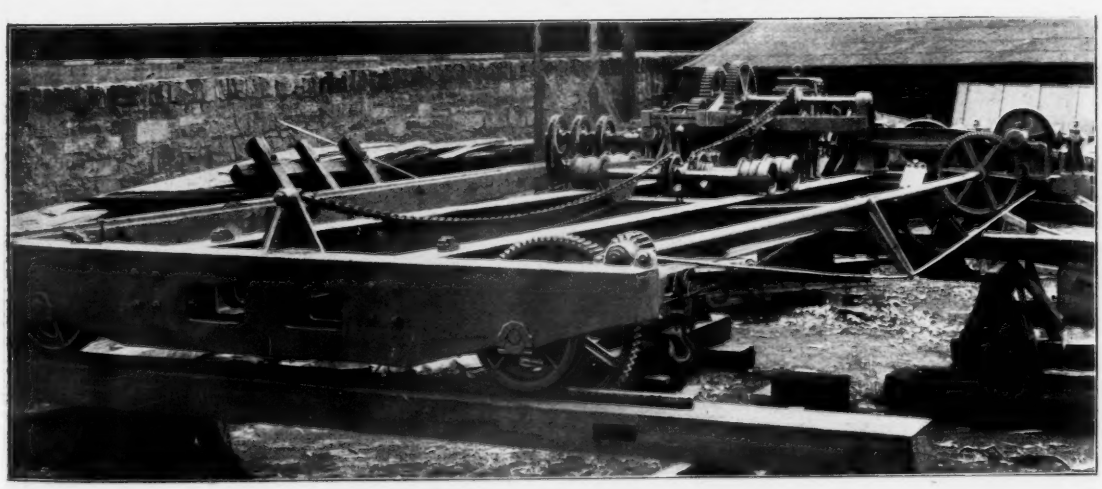


Fig. 8.

smoother in action than chains; it is invariably used in ordinary workshop practice. The control of the crane is very simple; it is easily worked by a boy.

So far we have been concerned with cranes in which all the motions are operated by means of a single motor; this is usually kept running all the time the crane is at work. The use of a separate motor for each motion is, however, to be preferred, on the grounds both of simplicity of gear and of economy in operation. When this system is adopted, it is better to use series motors, which have the advantages of

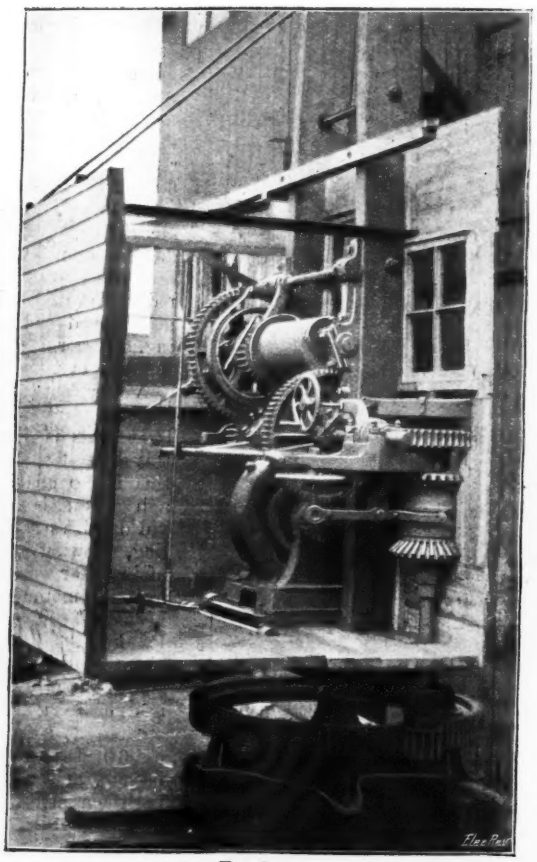


Fig. 9.

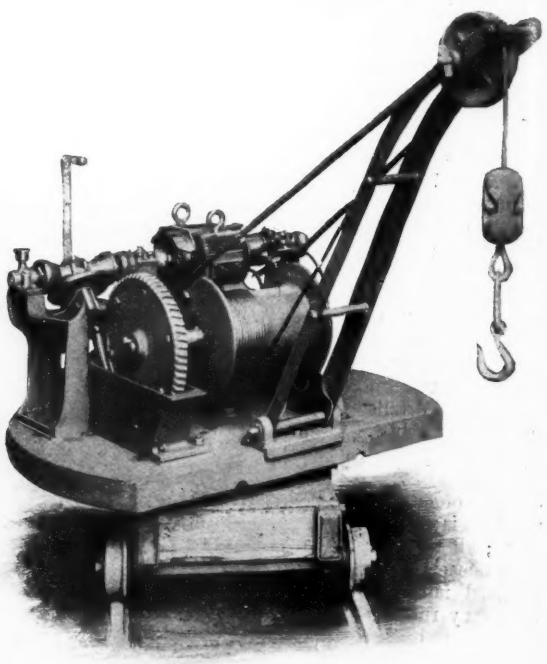


Fig. 10.

large initial torque and automatic adjustment of speed to load over a wide range; so that when light loads are being handled the speed is high, while heavy loads are dealt with at a suitably low speed.

An overhead traveller for lifting 10 tons, fitted with three

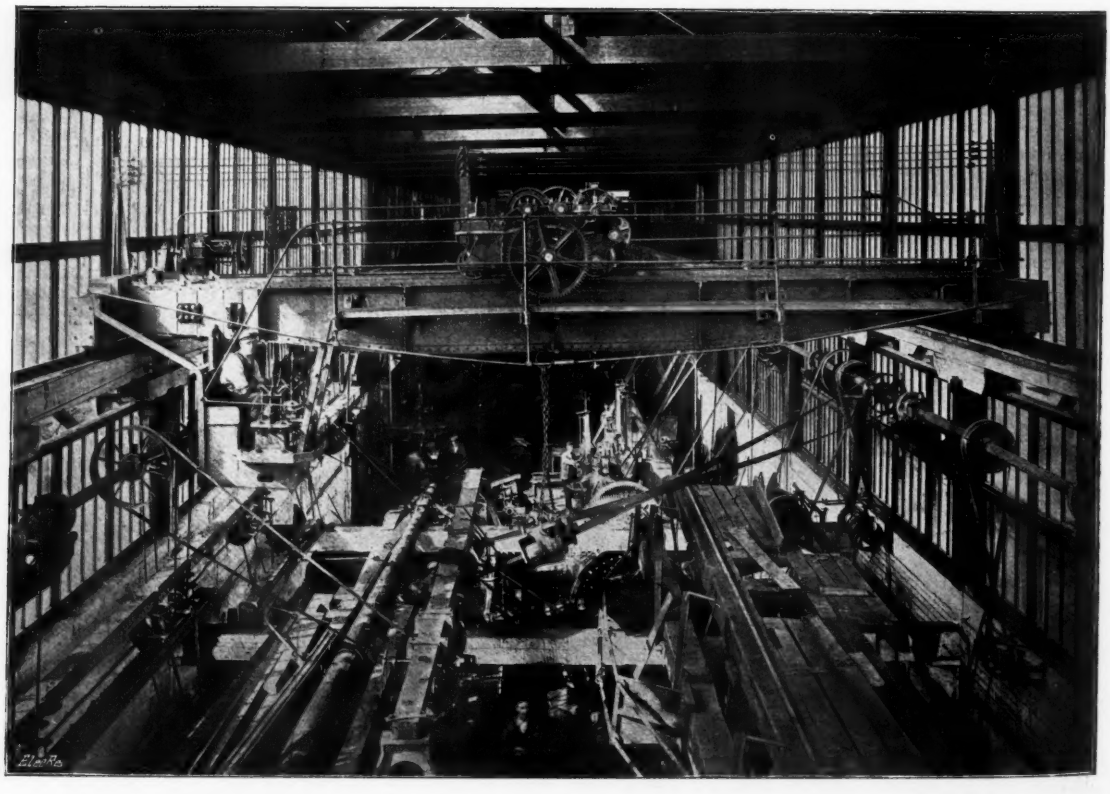


Fig 11.

motors made by Messrs. Scott & Mountain, Limited, is illustrated in fig. 11, as erected in the shops of the latter company by Messrs. Carrick & Ritchie. Similar cranes are made for 3 to 15 tons; they are built almost entirely of steel, and the first motion pinions and wheels are either of steel or gun-metal. All the shafts are fitted with covers to facilitate their removal and the renewal of the bearings. Platforms are fitted on each side, and hand gear is provided for use when electric power is not available, as, for instance, on holidays. The load is lifted by a steel wire rope and return block, the latter having a swivel hook in ball bearings. An automatic brake is fitted, and is controlled by the working current, so that directly the lifting motor is put in gear the brake is released, and *vice versâ*. The motors are controlled by means of liquid resistances fixed in the cage, where the attendant is stationed. The four wires conveying the current to the lifting and cross-traversing motors are seen in the figure, with the tubular sliding shoes by means of which the connection is made.

(*To be continued.*)

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

(*Continued from page* 802.)

Newport.—The County Council last week discussed the clauses for its Bill to be promoted in the next Parliamentary session asking for powers to use the overhead electric trolley system for the tramways. The work is estimated to cost about £120,000. The joint committee decided to obtain the energy from the present electric light works, but the expert who was called in reported that the present works could not be used for the dual purpose of supplying current for lighting and traction, and he recommended a site in Corporation Road. This site was, however, opposed by Lord Tredegar, and the Crindau site substituted.

Plymouth.—Mr. J. H. Rider, the electrical engineer to the Corporation of Plymouth, has prepared a report on the extension of plant necessary for supplying current to the Compton section of the tramways which it is proposed to equip for electric traction. The present tramway plant consists of two 100-KW. steam generators, one being a spare, and a battery of accumulators. The battery is used in conjunction with the plant in the day, and can in the evening, if necessary, take the whole of the six cars now running on the Prince Rock section. When the proposed extension is made, there will be 16 or 18 cars running. To provide power for these, Mr. Rider proposes to put down in the present buildings a generator for 450—500 KW., driven by a steam engine of 700 H.P., and also two additional Lancashire boilers, as well as a battery of accumulators at a substation near the tram route. The total cost of this extension is estimated at £20,000. The additional plant would more than double the possible output of the works, and enable them to add immediately some £4,000 per annum to the revenue, while the additional charges, including sinking fund and interest on the outlay, would not exceed £3,148 per annum. The Electric Lighting Committee have decided to invite tenders for the plant, and to apply for authority to borrow money. The Town Council has endorsed the decision.

Royton.—After considering correspondence from the Rochdale Corporation, the Royton District Council has decided to inform the Corporation of its intention to acquire the existing tramways, and alter or reconstruct them as may be necessary to make the gauge conformable with the Oldham and Rochdale lines.

St. Helens.—The directors of the St. Helens and District Tramways Company on 8th inst. inspected the Peasley Cross electrical section, which is ready for the Board of Trade inspection and sanction. Great difficulty has been experienced in rendering this section workable on account of the railway bridge crossing Peasley Cross Lane being so low that the electric trolley could not possibly be worked under it. For some years a controversy has existed between the Corporation and the London and North-Western Railway Company as to who is responsible for restoring the bridge to its proper height. The bridge and road at this point have sunk two or three feet on account of colliery working. Pending the settlement of this point, a Liverpool paper says that the tramway manager, Mr. Cuttler, has had the standard on which the trolley is carried reduced in height, so that the large bogey car used for the directors' inspection was able to pass safely under the bridge. It is not yet clear whether the Board of Trade will be able to sanction the carrying of passengers on the top deck of the car on account of the danger from this bridge being so much below the standard height.

Springhead.—The District Council has decided to grant an interview to the directors of the United Kingdom Light Railway and Electric Tramway Company with reference to the proposed scheme for the district. The Saddleworth Council is also granting an interview.

Tunstall.—The Urban District Council on 8th inst. decided to make application to the Board of Trade for a provisional order authorising them to supply electricity for public and private purposes within the district of Tunstall, and also in the parishes of Golden Hill and Chell. In October the clerk received a letter from the engineer of the Potteries Electric Traction Company stating that on the following Saturday the company would begin to run cars every half-hour from Tunstall Town Hall to the northern boundary of the town. Two days later he received another letter to the effect that owing to unforeseen circumstances they were compelled to postpone the opening of the line to Golden Hill. Since then he had not heard anything. The surveyor said that the Board of Trade had stepped in and prevented them from running. Mr. J. N. Peake said there was no doubt the company was playing the fool with the Council. He moved that the company be not allowed to run cars into Tunstall until they were prepared to open the line to the northern boundary. Mr. Peake's resolution was carried.

Walthamstow.—The District Council has decided that electricity should be the motive power of the new tramways, and that six lines should be constructed through the principal thoroughfares.

Wolverhampton.—At last week's Council meeting, Alderman C. T. Mander moved the adoption of a special report of the Tramways Committee, relative to the proposal by a syndicate to lay down an experimental line of surface contact tramway on the Wednesfield Road for the purpose of testing. An abstract of the report appeared in last week's ELECTRICAL REVIEW. Alderman Mander explained that the syndicate had proposed to lay a tramline in a field in Wolverhampton in order to experiment. He brought the matter before his committee, and they thought that a tramway in a field would not be as fair a test of wear and tear as would be obtained if the line were laid on a public road. As the result of a consideration with Mr. Thomas Parker, the representative of the syndicate, who had the system in hand, the committee suggested the laying of a line on the Wednesfield Road. The town would be put to no additional expense. If the committee did not like the system, the line would simply be left for some other method of traction. Alderman Marston said he totally objected to the committee's proposal. He objected to any part of their streets being handed over to a syndicate for experimental purposes. He added that the system of traction mentioned had not been successful anywhere. Alderman W. H. Jones agreed with Alderman Marston, and said that in the trolley system they had a thoroughly economical and successful system, while the conduit and street systems had been failures. Councillor Greensill said that the present was the time to test the system. It was not the syndicate, but the committee, who wished the experiment to take place in the street. As several members of the Council said that the committee's report should be presented at another meeting of the Council, Alderman Mander intimated he was willing to consent to it going back to the committee for reconsideration, and this was agreed to.

TELEGRAPH AND TELEPHONE NOTES.

African Trans-Continental Telegraphs.—The *Times* Berlin correspondent says that an agreement under the dates March 15th and October 28th, 1899, has been concluded between the German Government and the African Trans-Continental Telegraph Company, according to which the company receives permission to carry through German East Africa the African North-to-South Telegraph line designed to connect Cape Town with Cairo. The chief provisions of the treaty are to the following effect:—

1. The construction of the telegraph line will be carried out by the company at its own cost and must be completed within five years.
2. The company has to erect at its own cost, between the two stations nearest Rhodesia on the South and nearest British East Africa on the North, a telegraph wire intended for the service of German East Africa. The cost of maintaining this wire shall be borne by the company.
3. The German Government reserves the exclusive right of establishing and working telegraph stations in German East Africa, and of introducing for such stations the tariffs for German East African messages.
4. The German Government has secured the control of the line with its territory by the reservation of perfect liberty to connect the wires with an apparatus (*Durch beliebige Einleitung der Drähte*) at any point between the two stations mentioned in Article 2 of this agreement.

Furthermore the company has to pay a tariff of 10 centimes per word to the German Government.

(The two last-mentioned conditions, which are very onerous for the company, may, according to the agreement, be dropped in exchange for the concession by the company of advantages of equal value in some other sphere.)

5. On the expiration of 40 years after the completion of the telegraph line through German East Africa the German Government has the right to take over the German East African section of the line without payment. The cost of maintenance will then fall upon the Government. The company will, however, have to pay the Government a yearly transit charge amounting to the whole of the annual cost of administration, provided always that this payment shall not exceed the amount of one half-penny per word.
6. The company is bound to transmit over its lines at its general tariff charges all telegrams received by it for and from German East Africa; and the company has further declared its willingness to accord, in favour of all telegrams transmitted to or from German East Africa, any reductions of tariff which it may accord to third parties.
7. Detailed provisions have been incorporated in the agreement with a view to safeguarding German sovereign rights and the jurisdiction of the Governor of German East Africa with reference to the company and those in its employment. For one thing, the Governor can at his own discretion grant the employés and workmen of the company a military escort, the expense of which shall be borne by the company in so far as it does not exceed £1,000.
8. All differences arising out of the interpretation of the treaty shall be settled by a Court of Arbitration. In the first instance one of the two arbitrators shall be chosen by each of the two parties. In the case of non-agreement on the part of the arbitrators a third arbitrator (umpire?) may be appointed by the President of the German Imperial Court of Justice on the application of both the parties.

American Pacific Cable.—The *Morning Post* correspondent at Washington says that the report of the committee appointed to investigate the advisability of a Pacific cable has been handed to the President. It urges that the cable should be begun as soon as the necessary preliminaries can be attended to. The route laid down in the report runs from San Francisco to Hawaii, thence to Wake Island and Guam, and from there to Manila. It is suggested that the cable be afterwards run to Yokohama. The report will be submitted to Congress, and will, it is believed, be fully approved.

A Damaged Cable.—The *Edinburgh Evening Dispatch* says that for some days past operations, when weather permitted, have been carried on in connection with the repair to the Forth cable between Granton and Burntisland. This cable was damaged during one of the recent gales by a ship's anchor fouling it. In consequence of the cable-laying steamer *Monarch* undergoing a refit, the large steam tug *Empress of India* is temporarily fitted up with the necessary appliances on board, and under the superintendence of officers from the *Monarch* the work is being carried on.

German Cable Steamer.—On Wednesday, 8th inst., was launched at Messrs. David J. Dunlop & Co.'s shipbuilding yard, Inch Works, Port Glasgow, the s.s. *von Podbielski*. The event is chiefly of interest owing to the fact that she is the first cable steamer built for Germany, being named after the present chief of the German Postal Administration. The *von Podbielski* has been built for meeting the requirements of a modern cable repairing steamer more than as a cable-laying steamer; and with a good speed, twin screws, a light draught and the latest designed cable machinery, she should in every way prove satisfactory. From a shipbuilding point of view, she is built to meet all the requirements of the highest class of the Germanischer Lloyd. The following are the chief measurements:—Length between perpendiculars, 255 feet; breadth (moulded), 35 feet; draught (loaded), 16 feet 6 inches. The two sets of engines will give her a speed of 13 knots when loaded, and it is thought that she will be the fastest cable steamer afloat. The steamer is fitted with a paying-out machine aft and a new design of picking-up machine forward, built of steel, with two drums and two separate sets of engines, and can pick up under a strain of 25 tons. The ship is flush decked, is fitted throughout with electric light, has a powerful search-light and all the latest improvements. Her owners are the Norddeutsche Seekabelwerke Aktiengesellschaft in Cologne, who have a factory in course of construction at Nordenham, near the mouth of the Weser, the technical control of which will be in the hands of the well-known firm of Felten & Guilleaume, Karlswerk, Mülheim-am-Rhein. She will be principally engaged in the repairing and laying of the German Government cables in the North Sea, Baltic and Channel.

Hull Telephones.—At the last City Council meeting it was resolved to appoint a special committee to report upon the desirability of establishing a municipal telephone service for Hull and district. Mr. Brown stated that the Hull Chamber of Trades had already secured the names of about 1,100 subscribers of £5 5s. each for such a system.

International Telephone Communication. — The Communal Council of Zurich has offered an annual guarantee of £420 to the Ticino Cantonal authorities in respect of the projected international telephone line between Lugano and Zurich.

The Mutual Telephone Scheme.—The Altrincham, Sale, and Stretford Urban District Councils have approved of an application of the Mutual Telephone Company, Limited, for a license enabling the said company to establish a telephone system in their respective districts, and have undertaken to afford reasonable facilities for the carrying out of the provisions of such license, including underground way leases. At the Stretford meeting, an application of the National Telephone Company to construct an underground cable along Chester Road from the city boundary to Old Trafford Bar was again adjourned.

News from the Seat of War.—In consequence of the "interruption" to the Mozambique-Delagoa Bay cable, which occurred on the 31st ult., we have to rely for news from Natal on the line which runs along the West Coast of Africa, and thence reaches the front by landline. The *Globe* has the following rhyming reference to the inconvenience thus caused:—

Alas! 'tis in vain that we scan
The sheets of the "Latest Edition";
For news of a man in the rear or the van
Is always delayed in transmission.

Oh! how can the man in the street
Discover the present position
Of the fighting *élite* in the army and fleet
When the news is delayed in transmission?

Some eventide posters will show
That the Boers have been sent to perdition.
Was it yesterday? No. It occurred at Glencoe.
And was somehow delayed in transmission.

So, postal authorities, use,
If it's possible, more expedition.
We give you your dues, but news is not news
When it's always delayed in transmission.

A Simple Method of Re-establishing Telegraphic Communication over Short Distances.—Dr. Oliver Lodge writes to the *Times* as follows under the above heading:—"It is rash unasked to offer suggestions to practical telegraphists such as, no doubt, exist inside and in the vicinity of Ladysmith, but perhaps it might be worth while by cable to request them to try to communicate by the following method: Lay a wire across Ladysmith, or other invested station, east and west, and earth the two ends thoroughly, so as to get as long a base as possible. Insert in this wire a powerful battery, or a dynamo, and a signalling key (sharper signals can be got by breaking the current under alcohol or between the poles of a strong magnet); insert also, by an alternative switch, a pair of low resistance telephones, and a condenser to keep out steady earth currents. Then let another party, south of the above district and as near as is consistent with military exigencies, lay or utilise another east and west wire, of greater length than the other, and likewise thoroughly well earthed at each end in damp soil, employing salt if necessary, or, still better, utilising a river; and let them likewise insert a pair of telephones (with a condenser) to receive signals, and a dynamo or battery with a signalling key to send them. It matters little where the outside actual station is, but its two 'earths' should be as near and as much one on each side of the invested station as is practicable. Unless the soil is hopelessly dry for all accessible depths, slow signalling by this method of earth-tapping can certainly be achieved, provided strong enough currents are used, even without the use of special apparatus; the short and the long signals of the Morse code being marked by the beginning and end of the current, or by the interval between two successive reversals, and being readable by an operator skilled in the use of the 'sounder.' Earth current disturbances will be heard, but can usually be recognised and disregarded. An alternating dynamo would be preferable to a continuous current dynamo if it were of high frequency, and sometimes the harmonics of an ordinary alternator are sufficiently strong for the purpose; or a revolving commutator can be made to carve an ordinary battery current into rapid intermittencies, producing a hum in the distant telephone, as in the arrangement applied under the direction of Sir W. Preece in the sea near Cardiff. A great number of refinements could be applied if there were plenty of time, but my object is to point out that a slow kind of telegraphy can almost certainly be re-established, if it be considered worth while, with apparatus probably already on the spot. (The possible use of the line of rails as a semi-connector, or earth substitute, should not be overlooked.) To avoid difficulties about 'calling,' or asking for a change from 'send' to 'receive,' it is natural to suggest that each station should 'receive' for every alternate hour, and then the skilled operator rests. The 'sending' demands much less skill than the 'receiving.' A telephone held to the sender's ear, and connected, if necessary, to a couple of iron pegs in the earth in his immediate vicinity, or to a yard of wire running parallel to his line wire, will tell him if he is sending signals in an intelligible manner or not."

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
West Indies:—		
Jamaica-Colon	June 30, 1899 ...	...
Trinidad-Demerara (1871 original)	Oct. 20, 1899 }	Nov. 9, 1899.
Do. do. (1891 duplicate)	Oct. 6, 1899 }	one cable restored.
South African:—		
Lourenco Marques-Mozambique ...	Oct. 31, 1899	...Nov. 15, 1899 (?)
Zanzibar-Mombasa	Oct. 27, 1899 ...	...
Cayenne-Pinheiro	Oct. 11, 1899 ...	...
Havre-Waterville	Oct. 25, 1899 ...	...
Latakia-Cyprus	June 20, 1899 ...	...
Landlines.		
West Indies:—		
Cuban Government lines	Oct. 30, 1899 ...	...
Communication with Aquin and Les Cayes, Haiti	Nov. 10, 1899 ...	Nov. 10, 1899
Line to Port de Paix, Haiti	Nov. 10, 1899 ...	Nov. 11, 1899
Communication with Jeremie and Port de Paix	Nov. 14, 1899 ...	...
South African:—		
Communication with Mafeking ...	Oct. 13, 1899 ...	...
Communication with all offices beyond the Orange River ...	Oct. 18, 1899 ...	...
Communication beyond Burghersdorp, Cape of Good Hope, and Estcourt, Natal	Nov. 7, 1899 ...	...
Colombian Government lines to Bogota	Oct. 31, 1899 ...	...
Communication with interior of Colombia, excepting Amalfi, Ambalema, Buga, Cartago, Ibague, Manizales, Medellin, Palmire, Pasto, Popoyans, Reinedos, Sonson, and Santo Domingo... ...	Nov. 6, 1899 ...	...

The Telegraph Wire Export Trade.—Not for a long time has the export trade in this country in telegraph wire and apparatus connected therewith been so active as during the past month. The returns just issued show that the value of such shipments during October amounted to no less than £369,243, as compared with only £44,512 in the preceding month, and £89,313 in October last year. The briskness during the month just ended has wrought a considerable change in the figures for the year's shipments to date. At the end of September the total was £116,071 behind that for the same period of 1898. At the end of October this decline had been changed to an increase of £163,859, the value of the exports during the 10 months ending with October being no less than £1,100,580, as against only £936,721 in the corresponding period of 1898.

Telegraph Cables in the Spanish-American War.—Sir Edward Sassoon has written to the *Times* as follows with reference to some remarks made by the Marquis of Tweeddale at last week's meeting of the Eastern Extension Telegraph Company:—

I am very loth to encroach upon your space, but the persistence with which Lord Tweeddale adheres to his statement that the Cuban telegraph cables were not interfered with during the Spanish-American war ought not to be allowed to pass without remark. I therefore crave your indulgence to make a few short quotations from Lieut. Cameron McR. Winslow's "Cable cutting at Cienfuegos" (May 11th, 1898), in the *Century Magazine* of March last. Regarding one cable the writer says:—

"At this point the *Nashville's* launch stopped and began to cut the cable. Axes and cold chisels were tried, but the hack-saw, a small hand saw about 9 inches in length used for cutting metals, was found to be the most effective. With this saw, by frequently changing the men, the cable was cut through in from 20 minutes to half-an-hour."

And, again—

"And it was again cut, this time by men in the *Marblehead's* boat, the end being left in 13 fathoms of water. The piece taken out was about 150 feet in length."

Concerning the second cable, the narrative states that—

"This cable was lifted and handled just as the first one had been, the *Marblehead's* launch cutting the inshore end and the *Nashville's* launch underrunning it to the westward and making the offshore cut. Out of this cable a piece about 100 feet in length was taken and coiled down in the *Marblehead's* boat."

These quotations are to the point and require no comment.

The Marquis of Tweeddale replies to this letter in yesterday's *Times* to the effect that he never made that statement ascribed to him by Sir Edward.

The Value of Submarine Cables.—The *Daily News* Paris correspondent says:—"After the Germans, the French, instructed by the experience of this war, are anxious to have cables of their own. The existence of a British cable monopoly has brought England one incidental advantage. It is able at present to control more or less the cables from South Africa. But if foreign Governments combine to break down the British cable monopoly nobody will rejoice more than the British public, who will benefit more from cable extension than any other country. For the French will never be able to lay cables across the oceans without heavy bonuses from their Government. The Conseil Supérieur of the French settlements of Indo-China decided yesterday, we learn by a message from Tonkin, to lay a cable from Saigon to Port Arthur, to connect with the Siberian overland wire, the cost of the new cable being borne entirely by the Colony. This extension, I may point out, must lead to competitive routes between Europe and Burma, Singapore, and Manila. There is a group of Deputies who are charged to advise the Government and Chamber on trade questions abroad. They are known as the Conseillers du Commerce Extérieur. Associated with them are the heads of the great trading-houses, and persons in the Consular and Colonial services. This group has just held a meeting. The chairman, Deputy Henrique, has called the attention of members to the question of submarine cables, which are mostly in English or American hands. The meeting decided unanimously to make urgent representations to Government on the subject."

Wireless Telegraphy and the War.—It is stated by the *Times* that on arriving at the front shortly Captain Kennedy, R.E., will proceed to open up communications between various camps by means of the Marconi wireless telegraphy. The Royal Engineer authorities are confident that it will be possible to establish efficient connections from 200 to 300 miles in extent.

CONTRACTS OPEN AND CLOSED.

OPEN.

Accrington.—November 18th. The Corporation wants tenders for cables, wires, street boxes, and connections for electric lighting. See "Official Notices" November 3rd.

Battersea.—December 4th. The Vestry wants tenders for arc lamps and posts. See "Official Notices" this week.

Bray.—November 20th. The Council wants tenders for jet condensing plant for electricity works. See "Official Notices" November 3rd.

Bury-St.-Edmunds.—November 22nd. The Town Council invites tenders for electric light fittings for certain public buildings. Specifications, &c., at the Borough Surveyor's office, Town Hall.

Darwen.—November 27th. The Corporation wants tenders for one Lancashire boiler and accessories, one tramway switchboard. See "Official Notices" November 10th.

Denmark.—December 28th. The Corporation of Aarhus is inviting tenders for the water-tube boiler plant, steam dynamos and switchboard, accumulators for electricity works. From our "Official Notices," November 3rd, further particulars may be obtained.

Dublin.—November 20th. The Board of Public Works is inviting tenders for the hire of plant, &c., required for the electric lighting of the State apartments, Dublin Castle, during the next Castle season. Specifications, H. Williams, secretary, Public Works office, Dublin.

Essex.—November 27th. The Governors of Felsted School, Essex, are inviting tenders for boiler, two 27-KW. steam dynamos, condenser, pipework, accumulators, cables, and switchboard for electric lighting. See "Official Notices" October 27th.

Glasgow.—November 20th. The Electricity Department wants offers for 10 miles of 2-inch cast-iron pipes. See "Official Notices" October 13th.

Greenock.—November 23rd. The Police Board is inviting offers for leasing the tramways within the burgh, and converting them into electric trolley lines. See "Official Notices" November 10th.

Hackney.—December 12th. The Vestry Electric Lighting Committee is inviting tenders for refuse destructors to deal with the whole of the refuse of the parish. Specification, &c., may be obtained at the offices of Mr. Robert Hammond, M.Inst.C.E.

Harrow.—December 4th. The Electric Light and Power Company wants tenders for a 150 KW. steam dynamo and switchboard extension. See "Official Notices" this week.

Hammersmith.—November 22nd. Tenders are wanted for wiring the stables depôt for the Vestry. See "Official Notices" this week.

Islington.—November 22nd. The Vestry wants tenders for condensing plant for the electricity works. See "Official Notices" November 3rd.

Lambeth.—December 6th. The Vestry is prepared to receive tenders for 25 arc lamps and posts. For particulars, see "Official Notices" November 10th.

Manchester.—December 2nd. The Tramways Committee wants tenders for 5,000 tons of steel girder rails and 250 tons of steel fish-plates. See "Official Notices" to-day.

Middlesbrough.—November 22nd. The Electric Lighting Committee wants tenders for condensing plant and pipe-work for the electricity works. See "Official Notices" October 20th.

Mistretta (Sicily).—December 31st. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Consul at Palermo, stating that tenders are invited by the Municipality of Mistretta, not later than December 31st next, for the establishment of a service of electric lighting in that town. Such particulars as have been received may be examined on personal application at the Commercial Department of the Foreign Office any day between the hours of 11 a.m. and 5 p.m.

Newcastle-on-Tyne.—November 30th. The Tramways Committee wants tenders for two 1,000-H.P. steam dynamos for electric tramway works. See "Official Notices" October 27th.

Port Alegre.—December 31st. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Minister at Rio, stating that tenders are invited by the municipality of Porto Alegre, not later than December 31st next, at 1 p.m., for the electric lighting of that town.

Portsmouth.—November 17th. The Council invites tenders for the supply of 40, 60, or 80 electric tramcars. See our "Official Notices" November 3rd.

Portugal.—November 22nd. Tenders are being invited, until 22nd inst., by the Royal Company of Portuguese Railways, for the supply of 8 tons of galvanised iron telegraph wire. Tenders to be sent to La Compagnie Royale des Chemins de Fer Portugais, Santa Apolonia. Particulars may be obtained from the offices of the company, 28, Rue de Chateaudun, Paris.

Plymouth.—December 8th. The Corporation wants tenders for tramcars, trucks, motors, trolley arms, &c. See "Official Notices" to-day.

Spain.—November 23rd. Tenders are being invited until November 23rd by the municipal authorities of Chiclana de la Frontera (Cadiz province) for the concession for the electric lighting of the town during a period of five years. Tenders are to be sent to Le Secretariat del Ayuntamienti de Chiclana de la Frontera (Cadiz), whence particulars may be obtained.

Swansea.—November 20th. The Corporation wants tenders for five Lancashire boilers with jet condensing plant, feed pumps, economiser, piping, &c., for electricity works. See "Official Notices" November 3rd.

CLOSED.

Aldershot.—Messrs. Parsons & Co. have obtained the order for the generating machinery for Aldershot Camp. The plant will consist of three turbo-generators of 250 KW. each, and one turbo-generator of 100 KW.

Asylum Lighting.—We understand from the *Contract Journal* that the following contracts have been given out for the Winwick Asylum, near Warrington. Contract No. 1:—Generating plant, including three sets of condensing engines or turbines, with directly-coupled dynamos, each of 100 KW. output at 220 volts; booster set, motors, surface condensers, cooling tower, steam and exhaust pipes, &c., C. A. Parsons & Co. Contract No. 2:—Switchboard, Edison & Swan Company; storage battery, Hart Accumulator Company.

Islington.—The Tudor Company has received the contract for a battery of 1,000 ampere-hour's capacity from the Vestry at £679. An exchange gives the list of other tenderers as follows:—

E.P.S. Company	£664
Pritchetts & Gold	642
Hart Accumulator Company	640
Chloride Electrical Storage Syndicate	640
Tudor Company (alternative)	610
W. C. Horne & Sons, Limited (Pollak)	572

Oldham.—The Council has given a contract to Messrs. J. Spencer, Limited, for the supply of tramway poles, amounting to £18,500, and also one to Messrs. Askham Bros. & Wilson, Limited, for steel points and crossings at £8,500.

Paisley.—The Town Council has agreed to purchase from Messrs. Babcock & Wilcox, Limited, three water-tube boilers, to be delivered respectively on 31st inst. and 10th and 23rd prox., and erected, including brick work, for the sum of £1,635. The Council has also accepted the offer of Messrs. T. and T. Vicars, engineers, Earlestown, for patent mechanical stokers with shafting for extension of the electric lighting plant at £430, the price quoted in May, 1897 (notwithstanding advance in cost of material and workmanship in the interim).

Rotherham.—The Council has accepted the following tenders in connection with the electric lighting scheme:—Boilers, Tetlow Bros., Hollinwood, £1,240; engines, dynamos, &c., W. H. Allen, Son & Co., £7,702; battery, D P. Battery Company, £755 10s ; switchboard, &c., James White & Co., Glasgow, £1,290 18s. 9d.; mains, Callender's Cable and Construction Company, London, £4,092 12s. 11d.; and the town clerk has been instructed to apply to the Local Government Board for borrowing powers.

Sheffield.—The *Contract Journal* says that the following tenders for electric lighting machinery have been accepted by the Town Council:—Tetlow Bros. (boilers), £1,240; W. H. Allen, Son & Co. (engines and dynamos), £7,702; D.P. Battery Company (battery), £755 10s.; J. White & Co. (switchboard, &c.), £1,290 18s. 9d.; Callender Cable Company (mains—solid system), £4,092 12s. 11d.

Wigan.—We understand that Messrs. W. T. Glover & Co. have secured the contract for electric light cables for the Wigan Corporation at £13,932; the boiler contract is in the hands of Messrs. Babcock & Wilcox at £4,500; that for steam dynamos, &c., is with the General Electric Company, Limited, at £9,187, whilst Messrs. Doulton will supply conduits at the cost of £2,725.

FORTHCOMING EVENTS.

Saturday, November 18th.—At 3 30 p.m. The Institution of Junior Engineers. Visit to the City and South London Railway Works, Stockwell.

Tuesday, November 21st.—At 8 p.m. The Institution of Civil Engineers. For further discussion: "The Waterloo and City Railway," by H. H. Dalrymple-Hay, M.I.C.E.; "The Electrical Equipment of the Waterloo and City Railway," by Bernard M. Jenkin, Assoc.M.Inst.C.E.

Thursday, November 23rd.—At 8 p.m. The Institution of Electrical Engineers. Meeting at the Institution of Civil Engineers, 25, Great George Street, Westminster, S.W. "The Cost of Steam Raising," by John Holliday, Assoc.M.Inst.C.E.; "Influence of Cheap Fuels on the Cost of Electrical Energy," by R. E. Crompton, Past President.

Friday, November 24th.—Institution of Mechanical Engineers. Lord Chas. Beresford, C.B., M.P., on "Openings for Mechanical Engineers in China." President, Sir W. H. White.

At 8 p.m. Electro-Harmonic Concert, Café Monico, Regent Street, W.

Tuesday, November 28th.—Manchester Society of Junior Electrical Engineers. Meeting at Deansgate Hotel, Manchester. Paper by Mr. J. H. Henderson on "Aluminium, Its Treatment and Use, as Applied to Electrical Engineering."

Wednesday, December 6th.—Institution of Electrical Engineers' annual dinner, Grand Hall, Hotel Cecil.

NOTES.

Royal Institution.—The annual course of Christmas lectures (six) specially adapted for young people will this year be delivered by Mr. Charles Vernon Boys, F.R.S. The subject will be "Fluids in Motion and at Rest." The first lecture will take place on Thursday, December 28th, the others being delivered on December 30th, and on January 2nd, 4th, 6th, and 9th, 1900.

The Medical Battery Company.—There is a notice in last Friday's *London Gazette* that this company, of 489, Oxford Street, W., resolved on 7th inst. to wind up voluntarily, it having been proved that the company cannot, by reason of its liabilities, continue its business. Mr. L. F. Aspinall, of 57, Elgin Crescent, North Kensington, W., has been appointed liquidator. The notice is signed "C. B. Harness, chairman."

Central Station Breakdowns.—After commenting editorially upon "a regular epidemic of interruption of electric lighting service in Great Britain during the present autumn," the text of its comment being the recent breakdown at the Hastings station, the *Electrical World* and *Engineer* says:—"We believe we are safe in saying that an interruption in electric lighting service is very rare in America, and almost unheard of in our larger cities. What the fundamental cause of this difference may be it is difficult to say. Possibly it lies in the greater latitude which appears to be allowed central station engineers in Great Britain with respect to the introduction of their own ideas in the way of changes from standard practice. In this country security of service is the prime consideration, and the engineer, with the fear of the hard-hearted Board of Directors ever before him, hesitates long before becoming responsible for anything involving untried elements."

The Babcock Superheater.—We have received from the Babcock & Wilcox Co. their catalogue of accessories, in which we find a description of the superheater we recently described, and the arrangement for flooding the pipes when not in actual use is illustrated. By this system of working, a superheater ought to have a very considerable durability. It appears that the usual provision of the Babcock & Wilcox Co. is a superheat of 100° to 150° F., with which an economy of 10 to 15 per cent. is regularly to be obtained. Care must, of course, be taken to drain the superheater after flooding, for which purpose it might not be amiss to interlock the main steam outlet valve with the superheater in order to prevent the former being opened when the superheater is full of water. We have already pointed out that the economy due to superheat is almost entirely due to its action in countervailing the effects of the cylinder metal. Our correspondent of November 3rd, Mr. Tatlow, complains that we should have assumed the theoretical saving of superheat on the basis of the application of heat at maximum temperature—an impossibility, of course, in practice. The formula quoted implies the use of feed water heated to the temperature of ebullition, and is, of course, not applicable to the constantly varying conditions of practice. We do not know that the theoretical formula is ever used in estimating economies in practice, but simply the method used by Mr. Tatlow of comparing the actual heat quantities as given in any steam table. Looked at from this point of view, the smallness of the amount of added heat in superheated steam is better perceived; but here again the effect is seen to be as much below as the ideal formula shows it to be in excess of actual results, which confirms the practical man's claim that superheating must be looked on entirely from the practical point of view, and will then be seen to depend very much for its effects on too little-considered items, such as clearance surface and the quality of such surfaces.

The Zeeman Effect.—In an extract from correspondence between Sir Norman Lockyer and Prof. Preston, printed in *Nature* in the issue of November 2nd, the latter defends his priority to Prof. Cornu in the discovery of the quadrupling of the spectral lines in a strong magnetic field. Prof. Preston published descriptions and photographs of triplets and quartets in a paper read before the Royal Dublin Society, December 22nd, 1897. Prof. Cornu announced his discovery of them in the *Comptes Rendus* in the course of 1898. Prof. Preston has since shown that in a stronger field the quartet is resolved into a sextet by the splitting of the outer lines.

The Electro-Harmonic Society.—The "ladies' night" concert of this society takes place next Friday evening in the International Hall of the Café Monico. The programme is a light one, and should prove enjoyable. Miss Olive Kennett and Mr. Charles Fry, whose Shakespearian recitals at St. George's Hall are so well known, will give dramatic sketches, while Mr. Fredk. Upton, of "sensational novel" fame, and Mr. Chas. Frood, will supply the humorous element. The remainder of the programme consists of ballads and instrumental pieces.

The O'Keenan Electricity Meter—Mr. O'Keenan has just presented to the Société des Electriciens a new electricity meter of his own invention. This meter consists in principle of a little electro-motor, which is connected as a shunt to a fixed resistance. The electromotive force generated by the motor, and consequently its angular speed, is proportional to the difference of potential between the terminals of the fixed resistance. Therefore the angular speed, or the indications of the meter, are proportional to the strength of the current to be measured; it is thus an ampere-hour meter. The apparatus consists of a fixed cylinder of soft iron; round this are arranged, concentrically, the two-pole pieces of a permanent magnet, which form the magnetic field. Within the annular *entrefer* revolves an armature, consisting of a support bearing bobbins, the wires of which are connected with a collector, on which rub two brushes conveying the current. The support is not conductive, therefore there is no fear of Foucault currents. Arrangements are made to overcome all passive resistances by means of a constant current sent into the armature. A watt-hour meter has also been designed. The magnetic field is produced by a permanent magnet, and an electro-magnet placed opposite. The electro-magnet is not saturated, and is excited by a shunt across the terminals of the total difference of potential. The two magnetic fluxes produced are in the same sense; by giving them the same value, we obtain a counter electromotive force proportional to the flux which diminishes as the difference of potential increases. We thus get a watt-hour meter which is exact as long as the variations of the difference of potential are slight. Special arrangements have also been made to make the apparatus work with alternating currents. The apparatus is quite air-tight, and is therefore protected from any dust which might soil the collector. The current in the armature is extremely small, and the fall of potential is very slight. No sparks are produced on the collector. The apparatus is independent of variations of temperature, and the armature moves in a very powerful field, and is entirely withdrawn from the influences of outer fields. These meters are graduated to indicate hecto-watt-hours under a certain determined difference of potential. These instruments have already been tried for some time, and have given very satisfactory results. They are constructed by the company that makes the Thomson meters.

Electric Leakage and Government Observatories.—At the Board of Trade on Wednesday, Sir Courtenay Boyle presided over a conference of representatives of electric railway and electric tramway enterprises on the one hand, and representatives of the Government interested in the Greenwich and Kew Observatories on the other. The *Times* says that the object of the conference was to ascertain the best means of dealing with the alleged interference with the delicate instruments in the observatories by the leakage which it is assumed will follow from the introduction of large systems of electric traction. After Sir Courtenay Boyle had opened the proceedings, interesting speeches were delivered by Prof. Rucker and the Astronomer Royal, who alleged that there must be magnetic disturbance; and by Sir Douglas Fox, Major Cardew, and others who would not admit that any interference with observatory instruments had at present been proved. As a result, a committee was appointed "to investigate the amount of magnetic disturbance produced in the neighbourhood of electric tramways and railways constructed and worked under the Board of Trade regulations; and to report as early as possible." The committee consists of Profs. Rucker, Ayrton, and Perry, representing the laboratories; Prof. Kennedy, Mr. H. F. Parshall, Major Cardew, and Mr. Brousson, for the electric traction companies; and Mr. A. P. Trotter for the Board of Trade.

Army Reserve Men.—We are pleased to note that the directors of Callender's Cable and Construction Company are allowing their Army Reserve men who have been called out on service, half pay, the money being paid regularly to their families. The employés have appointed a committee to make weekly collections for supplementing the amounts voted by the directors. Any surplus that there may be after the actual wants have been met, is to be reserved to meet the needs of any family whose head may meet with accident or death, or for the Mansion House Fund.

50-ton Overhead Traveller. — A 50-ton overhead traveller, made for the boiler shop of Messrs. Hick, Hargreaves & Co., is described in the *Engineering Times*. To cover a span of 50 feet, it occupies a head room between gantry rail and nearest roof tie of 9 feet 6 inches. The girders are double web section, built of plate and angles with 6 feet × 3 inches × ½ inch T stiffeners, the plates being $\frac{5}{16}$ thick and 5 feet central depth. The longitudinal speed is 200 feet per minute, and the cross traverse 100 feet per minute. There are two lifting barrels, one for 50 tons at $1\frac{3}{4}$ feet per minute, and for 25 tons at $3\frac{1}{2}$ feet per minute, the other for loads of 7 and $3\frac{1}{2}$ tons at 12 and 24 feet speed of lift respectively. The barrels are right and left grooved, and steel wire rope is used for the lift, which is 25 feet high. The hooks are fitted with ball bearing heads, and quick running gears are cut. The total weight of the crane is 95 tons when fully loaded. The electrical equipment contains three series wound motors with each its independent resistance, and Vaughan & Foster's patent reversing switch. These motors run as follows:—Hoisting motor, 300 revolutions per minute; cross traverse motor, 300 revolutions per minute; longitudinal motor, 600 revolutions per minute—slow speeds, which involve expensive and large motors, but eliminate the high gear speeds otherwise necessary, and with greater ease of stopping and reversing, presenting, it is claimed, advantages worth the price. The switches are of the liquid resistance type, placed in the operating cage. The brake is magnetic, and automatically applied and released as current is switched on and off the motors. If current fails, the brake acts at once, and sustains the load; but how this is done is not explained. Current is collected for the crane from two bare copper wires, stretched along the gantry girder, by sliders fixed to the operator's cage. Even in busy shops cranes rarely work more than 10 to 20 per cent. of the working hours. During the intervals there is no power consumed, and this renders an electric crane so much more economical than one with a flying rope, or a constantly revolving longitudinal shaft. Considerable numbers of electric cranes are being made by Messrs. Vaughan for large engineering workshops, including one of 125 tons for the Openshaw Works of Armstrong, Whitworth and Co., and nine light cranes for Hadfield's Steel Foundry Company, of Sheffield. Seven electric cranes have recently been completed for H.M. dockyard at Portsmouth.

Personal.—Mr. Robert Blackmore, superintendent engineer with the National Electric Supply Company, Limited, and late on staff of the St. James's and Pall Mall Electric Light Company, has been appointed city electrical engineer of Wakefield.

Mr. Geo. Taunton has been appointed secretary of the Consolidated Telephone Construction and Manufacturing Company in place of Mr. Charles Curtoys, who, we understand, has resigned through ill-health.

Mr. A. J. Lawson has resigned his position as engineer and manager to the County of London and Brush Provincial Electric Lighting Company, the Richmond (Surrey) Electric Light and Power Company, and the Scottish House-to-House Company (Coatbridge).

The Royal Society.—Among the papers read yesterday afternoon were the following:—

"Note on the E.M.F. of the Organ Shock, and on the Electrical Resistance of the Organ in *Malapterurus electricus*," by Prof. F. Gotch, F.R.S., and G. J. Burch.

"On the Least Potential Difference required to produce Discharge through various Gases," by Hon. R. J. Strutt.

"An Experimental Research on some Standards of Light," by J. E. Petavel.

Motor Car Meet.—The fourth annual meet of the Motor Car Club took place at the Hotel Métropole on Monday morning, and was followed by a run to Brighton. The great majority of the cars taking part were propelled by oil; "electricity, indeed," says the *Times*, "was just represented, and only a single steam vehicle—a lorry apparently bearing a heavy load of electrical plant—exhibited itself in Whitehall Place before the start." As is usual with these Brighton trips, some of the cars went a-missing on the road.

Electric Power Transmission in Sweden.—*Engineering* says that the large Ljungan waterfall at Olby, Sweden, is about to be utilised for industrial purposes. A company was formed some time ago, with a capital of 2,000,000 kroner, which bought the waterfall and the adjoining land, and in the beginning of last year the work was commenced. A canal was constructed to lead the river round the waterfall, above which a dam was built. The canal is about 2,700 feet long, and consists of three sections: the influx canal, 2,000 feet long; the passage from this down to and through the turbine house, about 170 feet long; and the exit canal, some 500 feet long. The influx canal, again, consists of three portions, of which the lower part, 500 feet long, is built of stone, being rather more than 30 feet broad and deep. About 15,000 cubic metres of stone have been required for the building of this canal, and the making of the upper end of the canal has entailed the removal of 30,000 cubic metres of earth. Also the building of the turbine house has necessitated extensive removals of earth (10,000 cubic metres), and it stands on a concrete foundation of 2,500 cubic metres. The building is about 130 feet long, and the inside height is over 60 feet. The water is led from the canal into the turbine house through five pipes of 6 feet diameter, and two of about 8 feet diameter. In addition to these there are several reserve pipes, which can be taken into use without much additional cost, should the erection of new industrial establishments make them desirable. The dynamos will be direct coupled to the turbines, and the electric power will be conveyed direct from there to the workshops. The water-power, which can be made available without interfering with that part of the stream which must be left intact, amounts to some 12,000 H P. About half of this power will be required for the two large factories, Olby Electro-Chemical Company and Olby Calcium Carbide Company. The latter is situated on the east, and the buildings of the former on the west, side of the canal. The Olby Electro-Chemical Company will manufacture chloride of potash according to a new process.

Correction.—Mr. A. Nichols Moore notifies us that he has not been appointed engineer-in-*chief* of the Blackpool and Fleetwood Tramroad Company, but engineer-in-*charge*.

Stegmann v. O'Connor (Appeal).—In the Appeal Court yesterday, the appeal of plaintiff in the action of Stegmann *v.* O'Connor, from a judgment given by the Divisional Court in February last, was heard. Judgment was reserved. A report of the case will be given next week.

The Climax Water-tube Boiler.—With reference to the article on the "Climax" water-tube boiler appearing in our issue of the 10th, Messrs. B. R. Rowland & Co., Limited, draw our attention to the fact that the question of burning bituminous fuel has been already provided for by means of specially designed fire-bricks arranged with air ducts to ensure perfect combustion.

Appointments Vacant.—The Radcliffe District Council wants an electrical engineer. See "Official Notices" to-day.

An assistant is wanted in the electrical engineering department at the City and Guilds College, Exhibition Road, at £100 a year. See "Official Notices" this week.

Lecture. — Under the auspices of the Sheffield Society of Engineers and Metallurgists, an interesting lecture was delivered on 13th inst. at the Technical Department of the University College by Prof. Ripper, M.I.C.E. The subject was "The Progress of Steam Engineering, as Influenced by Electrical Developments."

Marriage.—On 4th inst. Mr. R. G. Botting, managing director of the Aberdeen Electrical Engineering Company, Schoolhill, was married to Annie, eldest daughter of Mr. Andrew Stott, Douglas Hotel, at the Gilcomston Parish Church, Aberdeen.

Electrolytic Lamps.—According to the *American Electrician*, a patent recently issued to W. E. Irish describes a modification of the ordinary arc lamp, by means of which a rod or tube of some material which, when heated, conducts the current and emits light at a high efficiency, is substituted for the arc between two carbons, the arc serving as a means of heating this material and thereby starting the lamp. In one arrangement, the arc is surrounded by a sleeve of normally non-conducting oxide, of a rare earth, which is heated by the arc until it becomes a conductor; the arc then may be extinguished, leaving the sleeve incandescent. The idea is not without importance; if it is found that electrolytic bodies cost less for maintenance and electricity supply than arc lamps, we have here a ready means of converting the latter.

Monozite Sand.—We should be glad to receive any information from our readers regarding the use which is made of this material for electrical purposes.

NEW COMPANIES REGISTERED.

Watts, Rumford & Co., Limited (64,111).—This company was registered on November 8th, with a capital of £5,000 in £1 shares, to adopt an agreement with Charles Watts, and to carry on the business of electrical, heating, and general engineers, smiths, bellhangers, ironmongers, hardwaremen, coppersmiths, tool makers, boiler makers, iron and brass founders, suppliers of electric light and power, &c. The first subscribers (each with one share) are:—John Marales, jun., North View, South Shields, shipowner; Jamieson Robertson, 44, Norcott Road, Stoke Newington, N., shipowner; George W. Rumford, 18, Scafield Terrace, South Shields, engineer; John B. Rumford, 18, Scafield Terrace, South Shields, electrical engineer; Ralph W. Graham, 26, King Street, South Shields, solicitor; Ernest B. Biglan, 71, Frederick Street, South Shields, secretary; and Charles Watts, 33, Charlotte Street, South Shields, electrical engineer. The number of directors is not to be less than two nor more than seven; the subscribers are to appoint the first; qualification, £100; remuneration as fixed by the company. Registered office, Edinburgh Buildings, 34, King Street, South Shields, Durham.

Monobloc Accumulator Syndicate, Limited (64,142).—This company was registered on November 10th, with a capital of £20,000 in £1 shares, to adopt an agreement with Gustave Leve for the acquisition of certain inventions, to carry on the business of an electric traction and light company, to construct and maintain cables, wires, lines, accumulators and works, and to supply electricity for all purposes. The first subscribers (each with one share) are:—C. Wanklyn, Belgravia Mansions, S.W., gentleman; J. M. Gorham, 66, Victoria Street, S.W., engineer; J. F. Albright, 66, Victoria Street, S.W., engineer; B. M. Drake, 66, Victoria Street, S.W., engineer; G. Leve, 1, Lawn Road, Hampstead, gentleman; F. Belcher, 43, Ellora Road, Streatham, S.W., clerk; and A. Eaney, 25, Royal Road, Clapham, S.W., clerk. The number of directors is not to less than two nor more than four; the first are C. Wanklyn, B. M. Drake, J. W. Gorham, and J. F. Albright; remuneration, £50 per annum, and 7½ per cent. of the net profits, divisible. Registered office, 66, Victoria Street, S.W.

Loughborough and District Electric Traction Syndicate, Limited (64,124).—This company was registered on November 9th, with a capital of £1,000 in £10 shares, to construct, equip, and work by electrical or other mechanical or animal power any tramways and light railways at Loughborough, Leicestershire, and elsewhere. The first subscribers (each with one share) are:—R. P. Sellon, Queen Anne's Mansions, S.W., electrical engineer; B. Broadhurst, Jesmond, Wolverton Avenue, Norbiton, secretary; N. S. Russell, Old Rectory, Loughton, Essex, civil engineer; R. A. Dawburn, "Wierton," Sidcup, Kent, engineer; E. H. Tyler, 15, Kirkstall Road, Streatham Hill, S.W., engineer; W. E. Lane, 14, Durley Road, Stamford Hill, N., secretary; and J. McLachlan, 33, Agamemnon Road, West Hampstead, N.W., assistant secretary. The number of directors is not to be less than three nor more than five; the first are to be appointed by the subscribers; qualification, £100.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Chloride Electrical Storage Syndicate, Limited (35,389).—This company's annual return was filed on October 19th, when 80,000 "A" preference, 30,000 "B" preference, 100,000 "C" preference, and 12,500 founders' shares were taken up out of a capital of £262,500 in 80,000 "A" preference, 30,000 "B" preference, 140,000 "C" preference, and 12,500 founders' shares, all of £1 each. £1 has been called up on each of 65,000 "A" preference shares, and £65,000 has been received. £157,000 is considered paid on 15,500 "A" preference, 30,000 "B" preference, and 100,000 "C" preference and 12,500 founders' shares.

CITY NOTES.

Bolton Corporation Electricity Accounts.
Public lighting and private supply.

The electric lighting undertaking of the Bolton Corporation is one of the progressive undertakings that naturally seem to have location in the Lancashire and Yorkshire district. Originally designed by Mr. J. H. Rider, who left to get out the scheme for Plymouth, the business has been ably developed by Mr. Arthur Ellis, who had charge previously of the Southport works. One of the most interesting points in the general survey of the position of the undertaking is the comparatively small capital expenditure, while the works' costs are at the same time commendably low.

GENERAL STATEMENT.

	1897.	1898.	Increase.
Total capital expenditure ...	£57,038	£67,253	£10,215
Number of units sold	341,888	416,635	74,747
Number of lamps connected ...	32,000	43,740	11,740
Gross revenue	£6,693	£7,942	£1,249
Gross profit	£3,771	£4,536	£765
Average price per unit sold ...	4·01d.	4·02d.	·01d.

A useful feature of the accounts as printed, which might advantageously be imitated elsewhere, is the setting out on a side column of the figures for the previous year, so that a comparison between the current and last year's can be readily made. One misses, however, a detailed capital statement of expenditure, and some particulars which are usually given in the last table of the Board of Trade form. On the other hand, some useful statistics are published regarding the units generated and sold from the opening of the works, the length of mains, number and size of transformers, and appropriation of gross profits.

From the revenue statement it will be seen that there has been a slight increase in the receipts per unit sold, but this is more than counter-balanced by a drop in the returns due to sales of fittings, &c.

REVENUE STATEMENT.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase.
Sale of current ..	£5,720	4·01d.	£6,987	4·02d.	·01d.
Meter rents	157	·11d.	219	·12d.	·01d.
Supply of fittings ..	816	·57d.	736	·43d.	−·14d.
Sundry	...	...	...	...	...
Gross revenue	£6,693	4·69d.	£7,942	4·57d.	−·12d.

The following figures give the detailed particulars of units generated, &c.:—

	Units generated.	Private.	Public.	Total.	Unaccounted for.	Per cent.
1897 ...	486,836	331,382	10,506	341,888	131,914	27 0
1898 ...	560,375	406,306	10,329	416,635	132,500	23 6

The total length of mains laid amounts to 50,870 yards, supplying 559 consumers, with an average of 78 8-c.p. lamps each. This figure has remained remarkably constant since the beginning of the undertaking. The transformers in use vary in size from under 1 kw. to over 20 kw.:—

Less than 2 kw.	3 to 7 kw.	10 to 15 kw.	20-21 kw.
201	75	14	19.

The large proportion of small transformers must tell against economy, and the results are, therefore, exceedingly good, bearing this in mind. We believe that Bolton is one of the places where a conversion from alternating to continuous supply for the centre of the town is in contemplation.

COST OF PRODUCTION.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase.
Coal	£691	·49d.	£838	·48d.	−·01d.
Oil, waste, water, and engine room stores.	330	·23d.	347	·20d.	− 03d.
Salaries and wages incurred in generation and distribution.	999	·70d.	1,086	·63d.	−·07d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	90	·06d.	159	·11d.	+ 05d.
Works' cost	£2,110	1 48d.	£2,460	1·42d.	−·06d.
Rent, rates and taxes ..	223	·16d.	249	·14d.	− 02d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	372	·26d.	400	·23d.	−·03d.
General establishment charges, stationery and printing, law charges and insurance	·205	·14d.	231	·13d.	− 01d.
Other expenses	12	·01d.	66	·04d.	+ 03 l.
Total costs ...	£2,922	2 05d.	£3,406	1·96d.	−·09d.

In the costs increases are shown on repairs—still a most moderate item—and in "other expenses," but a total reduction of nearly one-tenth of a penny is effected, leaving the "total costs" at less than 2d. In 1896 a net loss of £270 resulted, which was charged to the rates. In 1897 this was turned into a net profit of £918, and in 1898 no less than £1,205 was left after paying all charges, as shown below:—

PROFIT STATEMENT.

	1897.	1898.
Interest on loans	£1,443	£1,599
Sinking fund for repayments	1,410	1,732
Net profit carried to reserve fund	918	1 205
Net profit carried to credit of rates	...	1,000
Gross profit	£3,771	£4,536

West India and Panama Telegraph Company, Limited.

The half-yearly meeting of this company was held on Wednesday at Winchester House, Mr. W. S. Andrews presiding.

The CHAIRMAN said that, as he led them to expect at the last meeting, there had been a considerable falling off in the receipts as compared with the period of the American-Spanish war. The increase shown at that meeting was earned owing to the war, and, as he then said, it was impossible to forecast what the future traffic would be after the war was ended. He also then regretted that notwithstanding the large reduction made in the tariff more than 12 months ago, there was not only no increase in the number of words exchanged with the British Islands, but an actual decrease. He could understand the decrease in money, but a decrease in the number of words exchanged, in the face of the large reduction, was another thing. Of course, it pointed to stagnant commercial relations. The report showed that events had not belied their anticipations. Not only had they got down to the commercial foundation, but that foundation had itself sunk down a little. After reminding them that they could expect no progress until the commercial state of the West Indies improved, he proceeded to refer to figures. The total for the half-year was £30,929, as against £39,612 for the period ended June, 1898—decrease, £8,683. In this £500 was included, owing to the Jamaica subsidy not having quite ceased in the half-year with which they were comparing, and which, therefore, would appear to show a further reduction, and certain rebates allowed to the company were also lowered in the half-year. Turning to the expenses, there was a small decrease of £212, notwithstanding the sum voted to the directors. Expenses of ships and cables were rather less. A pretty expensive renewal in the St. Lucia-St. Vincent section was charged to reserve. The result of all this was, that they were able to recommend the usual dividends on the first and second preference, and 6d. on the ordinary shares, carrying forward £379. They all wished that this were more, but under the difficult and discouraging circumstances they had had to contend with, that was the utmost they could accomplish. It became necessary for important reasons in connection with the altered nature of things in the West Indies to reduce the international tariff to and from Porto Rico on February 15th last. Fortunately, that reduction had resulted in an increase—a turn in the tide in the number of words sent—last half-year, and this had been mainly confined to Porto Rico, which the reduction affected. That island was now working under American rule, and the increase in the number of words exchanged with it was a decidedly encouraging feature. But notwithstanding the increased words, the revenue was still left lower than it was before the reduction, but it did point to an augmentation of the business which was what they had to depend upon. He was sorry to say that the ill fortune of the West Indies which had been so persistent, had pursued them in the period under review, for the islands were again visited with a disastrous hurricane. That mainly affected Montserrat, Porto Rico, and other islands. The company voted £120 for the relief of the consequent distress. Sir Cuthbert Quilter and Sir Neville Lubbock visited the West Indies and made recommendations to the Government. The West Indian Committee had shown themselves to be alive to the crisis, and the Colonial Bank had drawn attention to certain reciprocity arrangements between the islands and America, which it was believed would tend to very considerable improvement. That was really the crux of the position. Their revenues could not improve until the trade and commerce of the islands became more active. The Cuba Company's action against this company was not on for hearing, and it was not likely to be for a considerable period. The directors felt that the only thing was to try and keep things together, not to lose ground, but to keep pegging away, doing their best under the circumstances. Those circumstances might improve through reciprocity arrangements, and American, commercial, and other management in Porto Rico beginning to tell. He did not know if they might eventually get a little assistance elsewhere; that was a card that they had not played, because the opportunity had not arisen. He moved the adoption of the report and the declaration of dividends.

Mr. HOLMES seconded.

Several shareholders offered very lengthy criticisms of the action of the board in matters connected with the balance-sheet. A large ordinary shareholder (1,000 £10 shares), who described the under-

taking as a miserably wretched one, hanging on year by year like a man with a morbid disease, protested against the ordinary shareholders, whose dividend was only 6d. per share, being made to pay for sums subscribed to the distress funds. The preference shareholders ought to bear it. These subscriptions should be voluntary from shareholders personally. He thought the time was coming for winding up. Another shareholder thought that the £80,000 5 per cent. debentures should be redeemed, and an issue at a lower rate of interest made. Objection was raised to the interest on investments being placed to reserve account instead of going to the credit of the revenue account, while the interest paid for borrowed money was debited to revenue.

The various criticisms having been replied to, the report and accounts were unanimously adopted.

Prospectus.

Yesterday afternoon the list of applications closed in an issue of £150,000 4½ per cent. first mortgage debenture stock of the Castner-Kellner Alkali Company, Limited. The subscribed capital of the company is £300,000 in ordinary shares. The issue is made at 102 per cent., and the stock will be secured by a specific first mortgage to the trustees for the debenture stockholders of the whole of the freehold land, works, and buildings of the company, and by a first floating charge on all the other property and assets, present and future of the company. The issue is for paying off debenture loans carrying a higher rate of interest, and meeting other liabilities incurred in the completion of the works.

Stock Exchange Notices.—The Stock Exchange Committee have ordered the undermentioned securities to be quoted in the Official List:—Aluminium Company, Limited—further issue of 5,000 shares of £1 each, fully paid, Nos. 60,001 to 65,000. City and South London Railway Company—£150,000 5 per cent. preference stock (1891), £200,000 5 per cent. preference stock (1896), and a further issue of £225,000 consolidated ordinary stock, in lieu of preference and ordinary shares respectively, now quoted.

The Brazilian Submarine Telegraph Company, Limited.—An extraordinary general meeting of this company was held at Winchester House on Friday last. Mr. W. Andrews presided. He moved the confirmation of the resolutions which were passed at a meeting on October 25th. The resolutions were confirmed. The name of the company will henceforth be "The Western Telegraph Company, Limited."

The Western and Brazilian Telegraph Company, Limited.—On Friday last an extraordinary general meeting of this company was held at Winchester House, when the resolutions passed at an extraordinary general meeting on October 24th, 1899, were confirmed as special resolutions. Mr. W. S. Andrews presided.

Telegraph Manufacturing Company.—The directors announce an interim dividend on the ordinary shares at the rate of 6 per cent. per annum, free of income-tax, for the half-year ended September 30th last, payable 1st prox. The transfer books of the ordinary shares will be closed from 16th to 30th, inclusive.

Brush Electrical Engineering Company.—The letters of allotment in perpetual second debenture stock have been posted.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending November 11th, 1899, were £182 11s. 4d.; November 11th, 1898, £229 17s. 9d.; aggregate for half-year to date, £19,243 15s. 11d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending November 10th, 1899, were £2,997 19s. 6d.; corresponding period, 1898, £2,607 16s. 0d.; increase, £390 3s. 6d.

The Cape Electric Tramways.—The receipts for October were:—Cape Town, £11,602; Port Elizabeth, £4,547.

The City and South London Railway Company.—The receipts for the week ending November 12th, 1899, were £1,082; November 13th, 1898, £1,056; increase £26. Total receipts for half-year, 1899, £19,406; total receipts corresponding period, 1898, £19,359; increase, £47. Miles open, 8½.

The Dover Corporation Electric Tramways.—The receipts for the week ending November 11th, 1899, were £171 14s. 1d.; November 12th, 1898, £161 18s. 4d.; increase, £9 15s. 9d. Total receipts to date, 1899, £8,990 11s. 11d.; corresponding period 1898, £7,502 3s. 10d.; increase, £1,488 8s. 1d. Miles of track open, 1899, 8; 1898, 8. Car miles run, 1899, 4,633, 1898, 4,306. Number of cars, 1899, 11; 1898, 11.

The Dublin United Tramways Company.—The receipts for the week ending Friday, November 10th, 1899, were as follows:—D. U. T. Co., horse cars, £262 10s. 9d.; ditto, electric cars, £2,732 6s. 0d.; D. S. D. Co., electric cars, £710 17s. 3d.; total, £3,705 14s. 0d.; corresponding week last year—D. U. T. Co., horse cars, £2,286 6s. 5d.; ditto, electric cars, £352 2s. 10d.; D. S. D. Co., electric cars, £791 4s. 6d.; total, £3,429 13s. 9d.; increase, £276 0s. 3d. Aggregate to date, £81,979 16s. 10d.; aggregate to date last year, £78,903 13s. 6d.; increase to date, £3,076 3s. 4d. Worked:—The mileage open is 39 miles electrically, 5 miles by horses, as against 18 miles electrically, and 29 miles by horses, for the corresponding period last year.

The Halifax Corporation Tramways.—The receipts for the week ending November 12th, 1899, were £581; November 16th, 1898, £294; Car miles run, 11,947; 1898, 3,604. Number of cars, 1899, 28; 1898, 10. Total receipts to date, from April 1st, 1899, £19,474; 1898, from June 27th, 1898, £5,409. Miles of track open, 12; 1898, 3¼.

The Liverpool Overhead Railway Company.—The receipts for the week ending November 12th, 1899, amounted to £1,684; corresponding week last year, £1,436; increase, £248.

The South Staffordshire Tramways Company.—The receipts for week ending November 10th, 1899, were £739 19s. 5d.; November 11th, 1898, £660 15s. 5d.; aggregate receipts for 45 weeks £30,095 7s. 2d.; 1898, £28,547 11s. 11d.

STOCKS AND SHARES.

Wednesday Evening.

While business continues fairly active in the market for electrical supply shares, there is no special feature claiming particular attention. Investment orders still show themselves shy of coming into the Stock Exchange, and the cloud of dear money hangs gloomily on the horizon. Most activity is noticeable in the shares of the metropolitan companies. City of Londons, after their rise, have been sold, and consequently lost half the 10s. which they added to their price last week. Charing Cross, on the other hand, are improving, the old shares having risen to 10½ and the Preference to 6½. The latest issue are dealt in at about 10. Nothing fresh can be gleaned as to the company's exploitation of the City.

Pronounced dulness is the order of the day in London Electric Supply and South Londons. Both are pressed for sale, and the market does not want to buy either. Pressed for a reason as to why the shares should be so weak, the dealers are at a loss for an answer, and can only explain it by referring to the absence of buyers. It will be remembered that South Londons were affected in the same droopy way in the early summer, but appeared to get over their fit of depression, it was evidently for a time only.

Hampstead Electrics are once more being vigorously hawked for sale by the same firm of outside brokers upon whose attentions in this way we have previously animadverted. The persistent energies of the people in question call for another strong recommendation that the shares should be let severely alone. The price at which they are being offered may seem a tempting one to the guileless mind of an investor unfortunate enough to have already got some shares at par, but, as we have previously remarked, there are no buyers at all for these precious investments in the Stock Exchange, although there are plenty of only too willing sellers.

In the telegraph department the most striking feature is a rise of 10 in Commercial Cable stock, bringing it to 195. This, however, has caused less remark than a change of 2 per cent. in Easterns would do, so narrow is the market on this side of the water. The Anglo-American Companies, it is understood, are doing exceedingly well, and Anglo descriptions monopolise a good deal of the miscellaneous market's attention. The Deferred stock is recovering some of its old vivacity, and is confidently expected to reach 20 before the anxiously awaited dividend is out. For ourselves, we consider that the "B" stock has just as much chance, if not more, of rising to 120, at which the return is exactly 5 per cent. on the money.

Neither of the Eastern stocks shows much variation. Considering how rapid has been the rise in Eastern Ordinary, after its heavy fall, there is naturally a lull in the market, pending further developments with the coming Pacific cable. Had it not been for the threatened competitor, there is little doubt but that the company would be able to declare an enhanced dividend for the stockholders, for both this and the "China" company have profited largely by the Transvaal hostilities. Bearing in view the unsettled outlook ahead, both as regards the competition and scaling down of rates, we shall be surprised if either Board launches out into increased dividends for a year or two, at any rate.

Great Northern Telegraph (Copenhagen) shares are being quietly picked up, and vague reports circulate as to the excellent business which the company is doing, but no definite information is obtainable in the market.

What little interest is usually displayed over traction issues has quite fallen asleep this week. A well-known jobber in British Electrics said he never remembered such a quiet time in the shares. They are not offered, neither are they bid for. It would seem to require a miracle to make the prices move in one direction or the other. Other electric traction concerns are slightly easier. Anglo-Argentines can be bought at a shade under the middle price of 4. Buenos Ayres and Belgrano are 5⅜, and Calcutta trams marked 8⅜ on Tuesday. Blackpool and Fleetwood exhibit no change at 20, and Barcelona Tramway shares are a good market in the neighbourhood of 13. New General Tractions are lifeless; the price is 4 middle.

Writing on Wednesday night, as we have to do, it is, of course, impossible to say what effect will be produced upon the market by the important meeting of the Marylebone Vestry that will be held on Thursday. Dr. Fletcher Little is in the field with an ambitious proposal that the London County Council should take over the whole of the Metropolitan Electric Company's undertaking, including the generating station at Willesden, and sub-let various portions of it to the municipal bodies whom the purchase would mostly concern. This would, indeed, be what is familiarly termed a "large order," but, although it is hardly likely that the scheme will be passed in its entirety, it is quite possible that some modified form of it will be submitted in due course to the County Council. All this should help the market in Metropolitans pretty considerably, and holders would be well advised not to part with their shares for the present.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years.			Closing Quotation, Nov. 8th.	Closing Quotation, Nov. 15th.	Business done during week ended Nov. 15th, 1899.	
			1896.	1897.	1898.			Highest.	Lowest.
124,400£	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90	85 — 90	...	...
905,560£	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	65 — 68	65 — 69	68	66⅜
3,047,220£	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	116½—117½	117 —118	118	116⅞
3,047,220£	Do. do. Deferred...	Stock	...	...	18s. %	17 — 17½	17½ — 18	18	17 1/16
205,151	Brazilian Submarine Telegraph	10	7 %	7 %	...	15 — 15½	15 — 15¼	15⅜	15⅛
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	107 —111	107 —111	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2 — 3	2 — 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	180 —190	190 —200	195	...
1,332,523£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	103 —105	103 —105	104½	...
224,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½%	1 %	⅛— ¼	⅛— ¼	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	9 — 10	9 — 10	9⅜	9⅛
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	19 — 20 xd	19 — 20	...	...
12,981	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	9 — 10	9 — 10	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	103 —107%	103 —107%	...	...
60,710£	Direct United States Cable	20	3 %	3¼%	3¼%	12 — 12½	12 — 12¼	12¼	12⅛
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	101 —104	101 —104	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6½%	7 %	7 %	157 —162	157 —162	160	159
1,795,000	Do. 3½% Pref. Stock	100	...	...	...	99 —102	99 —102	99½	...
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	... ...	... ...	...	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	117 —122 xd	117 —122	118½	...
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	15½— 16	15½— 16	15 13/16	15½
16,300£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	...	99 —103	99 —103	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	100 —103	100 —103	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	118 —123	118 —123	...	...
35,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	99 —103	99 —103	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	100 —103	100 —103	...	...
300,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	101 —104	101 —104	...	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—3,000	25	4 %	...	...	101—104% xd	101 —104%	...	...
180,227	Globe Telegraph and Trust	10	4½%	4½%	5⅛%	11¼— 11⅜	11¼— 11⅜	11⅜	11¼
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	15½— 16	15½— 16	15 15/16	15 13/16
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	30 — 31	30 — 32	30⅞	...
89,500	Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	48 — 52 xd	48 — 52	51	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	...	106 —109	106 —109	...	...
71,000	Montevideo Telephone, Limited, Ord., Nos. 1 to 71,000 ...	1	...	...	...	¼— ½	¼— ½	...	...
84,000	Do. do. 5% Pref., Nos. 1 to 84,000	1	...	...	...	¾— 1	¾— 1	...	...
490,000	National Telephone, 1 to 490,000	5	5⅛%	6 %	6 %	5 — 5¼	5 — 5¼	5¼	5⅛
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	14 — 15	14 — 15	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	14 — 15	14 — 15	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5¼— 5½	5¼— 5½	5 7/16	5 3/16
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	100 —102	100 —102	101½	100½
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	¾— 1	¾— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	...	103 —106	103 —106	...	...
11,839	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	129 —134	129 —134	...	...
58,000	United River Plate Telephone	5	5 %	6 %	...	4¾— 5¼	4¾— 5¼	...	...
151,733£	Do. do. 5 % Debs.	Stock	...	...	...	105 —108	105 —108	...	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	%	...	99 —102	99 —102	100	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	102 —105	102 —105	...	...
389,521	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	104 —107	104 —107	...	...
88,321	West India and Panama Telegraph	10	1 %	1%	...	1½— 1⅝	1½— 1⅝	1⅝	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	...	10½— 10¾	10½— 10¾	...	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	...	9 — 10	9 — 10	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	...	105 —108	105 —108	...	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	...	98 —103	98 —103	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	...	4 %	6 %	7½— 8½	7½— 8½	8 3/16	...
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	...	9 — 10	9 — 10	...	...
80,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	9½— 10½	10 — 11	10½	...
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	6 — 6½	5⅞— 6¼	6 1/16	6
84,000	*Chelsea Electricity Supply, Ord., ...	5	5 %	6 %	6 %	8 — 9	8 — 9	...	...
100,000	Do. do. do. % Deb. Stock Red....	Stock	4½%	4½%	...	111 —113	111 —113	112	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	7 %	10 %	6 %	11¼— 12¼	11¼— 12	11 3/16	11⅜
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	13 — 14	13 — 14	13½	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	125 —130	125 —130	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	nil	nil	10 — 11	10¼— 11¼	11	10⅜
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	13 — 14	13 — 14	...	...
200,000	Do. 4½% Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	111 —114	111 — 114	112½	...
26,100	Edmundsons Elec. Corp., Ord. Shares	5	...	5 %	7 %	5 — 5⅛	5 — 5⅛	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	8	...	...	...	3½— 4	3½— 3¾	...	...
48,050	Do. do. do. 6 % Pref.	5	...	...	6 %	6½— 6⅝	6½— 6⅝	...	...
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	104 —106	104 —106	105½	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	15 — 16	15 — 16	15¾	15 3/16
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	14 — 15	14 — 15	...	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½%	4½%	...	117 —119	117 —119	...	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	15½— 16½	15½— 16½	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½%	14½%	14½%	15½— 16½	15½— 16½	16¼	16 1/16
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 9½	9 — 9½	...	...
65,000	South London Electricity Supply, Ord., £4 paid	5	...	...	...	3½— 4	3½— 4	3 13/16	3 11/16
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	9 %	12 %	12 %	14½—15½	14½— 15½	15½	14½

* Subject to Founder's Shares.
Unless otherwise stated all shares are fully paid.
† Quotations on Liverpool Stock Exchange.
‡ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation Nov. 8th.	Closing Quotation Nov. 15th.	Business done during week ended Nov. 15th, 1899. Highest.	Lowest.
60,000	Aluminium "A" shares, Nos. 1—60,000	1	10 %	10 %	...	2¾— 3¼	2¾— 3¼	...	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	95 —100	95 —100	...	...
30,000	British Electric Traction	10	...	...	6 %	16½— 17½	16½— 17½	17	...
30,000	Do. do. 6 % Cum. Pref. 30,001—60,000	10	...	...	...	13½— 14	13½— 14	14	13⅝
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	126 —129	126 —129	127½	...
40,000	British Insulated Wire Ord., Nos. 1 to 40,000	5	...	...	...	11 — 12	11 — 12	...	...
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,500 ...	5	...	...	...	6¼— 6¾	6¼— 6¾	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	nil	3 %	5 %	1⅝— 2⅛	1⅝— 2⅛	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	4 %	6 %	6 %	2¼— 2½	2¼— 2½	2 7/16	2 5/16
125,000£	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —115	110 —115	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	104 —107	104 —107	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	10 %	12½%	15 %	13 — 14	13 — 14	13½	...
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	113 —116	113 —116	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	10½— 10⅝	10½— 10⅝	10⅝	...
178,303	Do. do. do. £8 paid	10	...	...	...	...	...	...	...
61,033	Do. do. Pref. half-shares	5	...	...	...	4⅜— 5¼	4⅜— 5¼	5¼	5
71,447	Do. do. Def. do.	5	...	...	...	5 — 5½	5 — 5½	...	...
630,000£	City and South London Railway	Stock	1 9/16%	1⅞%	2⅛%	63 — 66	63 — 66	64	...
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 ...	10	...	...	...	6½— 6¾	6½— 6¾	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3½— 4	3½— 4	...	...
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	100 —103	100 —103	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5½%	6 %	6 %	2 — 2½	2 — 2½	...	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5½%	6 %	6 %	4 — 5	4 — 5	...	...
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	95 — 97	95 — 97	...	...
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2 — 2½	2 — 2½	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	3 — 3½	3 — 3½	...	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	104 —107	104 —107	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	¼— ½	¼— ½	...	...
9,600£	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	7 %	11 — 13	11 — 13	...	...
15,000	Henley's (W. T.) Telegraph Works, Ord.	10	10 %	12 %	14 %	...	...	...	...
8,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	...	...	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½%	4½%	...	111 —114	111 —114	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22	21 — 22	21½	21¼
800,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	100 —104	100 —104	102½	101¼
37,500	†Liverpool Overhead Railway, Ord.	10	2½%	3¼%	3¼%	9¼— 9½	9 — 9¼	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	13½— 13⅝	13½— 13⅝	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	37 — 41	37 — 41	37¼	37
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	103 —106	103 —106	...	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9¼— 9⅝	9¼— 9⅝	...	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5½— 6	5½— 6	...	...
540,000£	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	101 —104	101 —104	...	...

† Quotations on Liverpool Stock Exchange.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

‡ Unless otherwise stated all shares are fully paid.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8—10.
Brompton and Kensington, 4½% Debentures of £100, 105—108.
National Electric Free Wiring, 10s. paid, ¼—⅜.
Smithfield Market Electric, 1—3.

Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12—13; 1st Preference Cumulative 6%, £5 (fully paid), 7¼—7¾. Debentures, 104—107. Dividend, 1898, on Ordinary Shares 10%.
*T. Parker, £10 (fully paid), 18½.

* From Birmingham Share List.

Bank rate of discount 5 per cent. (October 5th, 1899).

MARKET QUOTATIONS, Wednesday, November 15th.

CHEMICALS, &c.	This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a " Nitric .. .. .. per cwt.	22/-	22/-	..
a " Oxalic .. .. .. per cwt.	32/-	32/-	..
a " Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per cwt.	40/-	40/-	..
a Ammonia, Muriate (crystal) .. per ton	£29	£29	..
a " " .. .. per ton	£27	£27	..
a Bleaching powder .. .. per ton	£6 10	£6 1	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. .. per ton	£16 10	£16 10	..
a Benzole (90 %) .. .. .. per gal.	7/-	7/-	..
a " (50/90 %) .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£25 10	£26	10s. dec.
a Lead, Nitrate .. .. .. per ton	£25	£25	..
a " White Sugar .. .. per ton	£31	£31	..
a " Peroxide .. .. .. per ton	£27 10	£27 10	..
a Methylated Spirit .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.) .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.. per lb.	8½d.	8½d.	..
a " Caustic (75/80 %) .. per ton	£34	£34	..
a " Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. per cwt.	68/-	68/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6	£6	..
a " Recovered .. .. per ton	£5 10	£5 10	..
a " Lump .. .. .. per ton	£5	£5	..
a Soda, Caustic (white 70 %) .. per ton	£7 10	£7 10	..
a " Crystals .. .. per ton	£8	£8	..
a " Bichromate, casks .. per lb.	2¾d.	2¾d.	..
METALS, &c.			
Aluminium Wire, in ton lots .. per ton	£294	£294	..
b " Sheet, in ton lots.. per ton	£191	£191	..
p Babbitt's metal ingots .. .. per ton	£90 to £160	£90 to £160	..
c Brass (rolled metal 2" to 12") basis per lb.	8¼d.	8¼d.	..
c " Tube (brazed) .. .. per lb.	10d.	10¼d.	¼d. dec.
" Wire, basis .. .. per lb.	8½d.	8½d.	..

METALS, &c. (*continued*).	This week.	Last week.	Inc. or Dec.
f Ebonite Rod .. .. .. per lb.	8/-	8/-	..
f " Sheet .. .. .. per lb.	5/-	5/-	..
g Copper Bars .. .. .. per ton	£86	£86	£1 dec.
g " Wire (basis price) .. per lb.	10¼d.	10¼d.	..
g " Sheet .. .. .. per ton	£86	£86	£1 dec.
g " Rod .. .. .. per ton	£86	£86	£1 dec.
n German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	7/-	7/-	..
h India-rubber, Para fine .. per lb.	4/4 to 4/6	4/3 to 4/5½	½d. to 1d. inc.
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i " Pig (Cleveland warrants) per ton	70/7½	69/10½d.	9d. inc.
i " Forgings, according to size per ton	From £11	From £11	..
i " Scrap, heavy .. .. per ton	50/- to 55/-	50/- to 55/-	..
i " Wire galvanised No. 8 .. per ton	£14 5	£14 5	..
g Lead, English Ingot .. .. per ton	£17 12 6	£17 12 6	..
g " Sheet .. .. per ton	£18 16	£18 16	..
m Manganin Wire No. 28.. .. per lb.	8/-	8/-	..
g Mercury .. .. .. per bott'e	£9 7½6	£9 5	2/6 inc.
d Mica (in original cases), small .. per lb.	2d. to 8d.	2d. to 8d.	..
d " " medium per lb.	1/9 to 2/9	1/9 to 2/9	..
d " " large per lb.	3/6 to 7/6	3/6 to 7/6	..
p Phosphor Bronze, plain castings per lb.	1/1 to 1/4	1/1 to 1/4	..
p rolled bars & rods per lb.	1/1 to 1/4	1/1 to 1/4	..
p r'l'd str'p & sheet per lb.	From 1/2½	From 1/2½	..
o Platinum .. .. .. per oz.	£3 11	£3 11	..
p Silicium Bronze Wire .. .. per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n p. ton	£40 to £40	From £15,	..
i Steel, Magnet, in bars	£58	£58	..
g Tin, block .. .. per ton	nominal	£143	..
g " foil .. .. .. per lb.	1/6	1/6	..
n " wire Nos. 1 to 16 .. .. per lb.	1/11	1/11	..
p White Anti-friction Metals—			
"White Ant" brand .. per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10lb. bundles pr lb	7¾d.	7¾d.	..
j " Best Flax, 6 lea. .. per lb.	5d.	5d.	..
j " Hemp, 8 ply 10 lbs. .. per lb.	8¾d.	8¾d.	..
j " Russian, 10 lbs. .. per lb	4¾d.	4¾d.	..
j " Jute, 180 lbs. rove .. per ton	£14	£14	..
k Zinc, Sheet (Vielle Montagne bnd.) p.t	£26	£26	..

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yee & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

VELVRIL: A NEW SUBSTITUTE FOR INDIA-RUBBER AND GUTTA-PERCHA.

The rapidly extending use of paper insulation for underground cables of all types is causing the question of rubber supply and price to become of less importance to cable manufacturers, but rubber is still used in large quantities for deep-sea cable insulation, and, therefore, the discovery and manufacture of an artificial substitute for it cannot be without interest for a large proportion of the electrical engineering profession.

On Monday evening, November 6th, Mr. Walter F. Reid, F.I.C., read a paper before the London Section of the Society of Chemical Industry, in which he described the manufacture and uses of a new rubber substitute, called "Velvril." Alluding to the possibility of the demand for rubber exceeding the supply of the natural product, Mr. Reid stated that the consumption is now estimated to be 60,000 tons per annum. The exports from Para show the greatest increase, the total shipped from this port in 1898 having been 25,000 tons, an advance of 3,000 tons upon the total for 1897. The Singapore variety of natural rubber shows, however, no such advance, and in 1898 the exports from this port only amounted to 2,600 tons. As this is the material most suitable for cable insulation, and as the last cable laid to New York required over 500 tons, or one-fifth the annual output for insulation, the situation of the cable manufacturer with regard to the supply of natural rubber is seen to be somewhat anomalous.

The new substitute for rubber is a mixture of nitrated linseed, or castor oil, with nitro-cellulose. The nitrated oil is prepared first, and is then mixed with the nitro-cellulose. A homogeneous mass is obtained, the elastic and other properties of which can be greatly varied by alterations in the proportions of the two constituents. The proportions which yield a product most closely resembling Para rubber are two pints nitrated oil and one pint nitro-cellulose. Castor oil yields better results than linseed oil. The elasticity of the product is 25 per cent. Its durability is greater than that of rubber, a sample of the product, after three years' exposure to all the vicissitudes of the English climate in the author's garden, having shown but slight marks of deterioration. The product can be moulded under heat and pressure, or it can be worked by dissolving in any suitable solvent, and then evaporating the solvent. When used for coating cables, the artificial product may either be applied in the form of a thick paste, the solvent being allowed to evaporate after each coating, or the solid product may be applied directly with the aid of heat and a pressure of 15 tons per square inch. The author considers that the latter method gives the best results.

Velvril may also be applied as a tape-wrapping of thin sheet, in the same manner that rubber is applied in the present method of cable manufacture.

Velvril is superior to vulcanised rubber, in that it is without action on copper. The author showed samples of copper wire coated in the manner described—with velvril—but he did not give any insulation tests of the new material, and in response to inquiries, stated that further experiments upon this use of velvril were in progress. The greater portion of his paper was devoted to the other applications of velvril, a mere enumeration of these showing the wide possibilities of the new substitute for rubber, *if* the price at which these manufactures can be sold will permit them to enter into keen competition with those produced from other materials by the older method of manufacture. As Mr. Reid studiously avoided the subject of *cost* in his paper, one may be excused for remaining somewhat sceptical on this point until further information is forthcoming.

The applications of velvril discussed by Mr. Reid were as follows: Machine belting, portmanteaus, camping-out sheets, loin cloths for horses, balloon materials, hose and tubing, carding wire foundations for spinning rollers, floor coverings, paints, enamelled leather, and fishing lines.

As the production of this new material has already entered upon the manufacturing stage, Mr. Reid was able to exhibit samples of its application to all the uses named above, and he also informed his audience that these were but *a selection* of the products turned out by the velvril factory at Streatham Common, S.W.

In the discussion which followed the reading of the paper, considerable attention was directed to the question of the explosibility of the artificial material, and of its readiness to become ignited, but Mr. Reid assured the inquirers that "velvril" was non-explosive, and not more inflammable than other organic products. A rubber manufacturer present tried to obtain definite information as to the cost per pound of "velvril," but Mr. Reid refused to be drawn upon this point—perhaps wisely.

The full report of the paper and the discussion will appear in the November issue of the *Journal of the Society of Chemical Industry.*

FUEL CONSUMPTION OF ELECTRIC TRACTION ENGINES.

The *Street Railway Review* publishes in its special issue a paper on the fuel consumption shown by a number of tests made by Prof. Carpenter with a view to pointing out the effect of condensing, &c., on economical performance. The number of tests embodied is 35. No duty is more variable than that called for from traction engines on street railway work. Simple non-condensing engines show an economy but little less than that usually secured from this class on ordinary and more steady work, or about 34·3 lbs. of steam per H.P.-hour, and 4·63 lbs. of coal, the best result on a steady load being that corresponding to about ¼ cut-off, and being 27 lbs. of steam per I.H.P.-hour, any other load, greater or smaller, increasing the consumption. An interesting and instructive curve shows how the increase of steam varies with the load. The total steam per hour increases faster than the increase of load, the curve of steam per I.H.P.-hour showing slightly over 27 lbs. at 120 H.P., and 30 lbs. at 150 H.P., 44 lbs. at 160 H.P., and 64·3 lbs. at 40 H.P., the total steam increasing faster than the increase of load. The total results of all tests show a steam consumption for this class of engine only 25 per cent. higher than when working under most favourable conditions. The curves given were obtained from tests of a straight line engine, 14 inches × 14 inches × 210 revolutions per minute. The straight line engine of Prof. John Sweet is perhaps the best finished of any horizontal engine made. In respect of finish and also of design it is a remarkable example of careful design and scientific construction.

The average of all simple non-condensing engines with slide valves shows 35·1 lbs. of steam per H.P.-hour, or, neglecting one engine which was in bad order, 34·3. The average power developed was 54·2 per cent. of the rated capacity, and the steam pressures 90 to 120 lbs. The figures are useful in other ways as showing the load factor and pointing to the necessity of keeping engines of moderate cylinder dimensions so as to be of economical size over the greatest amount of work.

The same class of engine, but with Corliss gear, showed an average steam consumption of 28·3 lbs. per I.H.P.-hour and a load factor 50·3 of rated capacity, but only three engines come into this list. Non-condensing compound engines were four in number and did not show much improvement upon the first class, the average of the two best being 32·28 lbs. of steam and the load factor 51 to 62·7 per cent. The engines were from 400 to 1,250 H.P. capacity. While the simple engine therefore is only 25 per cent. below its best performance on steady load, the compound falls 40 per cent. below its economical performance, and is therefore but little superior to the simple engine for traction work.

As soon as condensing is applied a great difference is seen. Compound condensing engines show an average steam consumption of 23·96 lbs. or, if extremes be eliminated, of 24·26, with load factors 32 to 47 per cent. The average of the middle four is only 22·7 lbs., a figure which may be taken as most probably correct for this class of engine.

Table I.

Class of engine.	Boiler H.P. per engine H.P.	Cost per H.P. shillings. Engine.	Boiler.	Pumps and heaters.	Piping, &c.	Total per I.H.P.	Cost of 500-H.P. plant.
Non-Condensing—							
1. Simple slide ...	1·135	32 0	54 4	8 0	10·0	114 4	£2,860
2. Simple Corliss ...	·933	48 0	44 8	8 0	20 0	120 8	3,020
3. Compound slide...	1 000	44 0	48 0	11 6	20 0	120 0	3,000
Condensing—							
4. Compound slide...	·75	44 0	36 0	16 0	24·0	120 0	3,000
5. Compound Corliss	·602	64 00	29·0	16 0	24 0	133·0	3,325

As most makers will guarantee such engines to run on 18 lbs. of steam under steady load, and many such engines have worked with as little as 15 lbs., it appears that the loss due to variable load is 30 to 40 per cent. One of the engines in this list actually did show as little as 16·7 lbs. These engines had simple slide valves. With Corliss or similar gear the steam consumption only averages 18·8 lbs. On steady load such engines can be expected to run on 15 lbs. per I.H.P.-hour, showing a loss of about 20 per cent. due to irregular load. The load factor varied from 27·7 to 72 per cent., and it is observed that the evaporation per pound of coal is better than in the lower class of engines—evidence clearly of a generally better class of station and superior men and probably of better fuel.

Omitting one test not on all fours with the other seven, the average steam is 18·25, and the coal 2·36 lbs. per I.H.P.-hour.

Assuming a boiler horse-power to mean 30·4 lbs. of steam, the author has given a table showing the cost of 500 H.P. of plant for the different classes of engines reviewed. (See Table I.) If the author's premises are right, it appears of very little use employing anything less economical than compound slide valve engines, the enhanced cost of which is balanced by the smaller boiler power required. It will be observed that boilers are considered to be worth 48s. per H.P. when erected. This would bring the cost of a large Lancashire boiler evaporating 8,100 lbs. per hour to about £650, a figure which is at least £100 or £150 below the cost of a high class boiler of that type placed on its seat and bricked in. For capitalising values coal is assumed at 8s. per ton of 2,000 lbs., and the day is taken at 18 hours. To the fuel cost per H.P.-year are added fixed charges, &c., equal to 8 per cent. of the cost of the plant. On this basis the total cost per H.P.-year for the five classes given in Table I. works out as follows for the 18 hours' day:—

Table II.

Class.	Shillings.	Class.	Shillings.
1. Average ...	130·84	4. Average ...	95 04
1. Best	129·96	4. Best	72·64
2. Average ...	100 32	5. Average ...	72·48
2. Best	88·80	5. Best	57 84
3. Average ...	118·16		

The facts appear, from these figures, that no station can afford to purchase and work simple non-condensing engines of any type, as

compared with the compound condensing engine, and that the best types of this latter class give better financial results than any other class; so much so, indeed, that no other inferior class can even be considered for power house work, though why the author should consider low speed of rotation to be also essential is not very clear.

PHYSICAL SOCIETY.

Ordinary Meeting held in the Physical Laboratory of the Central Technical College (by invitation of Prof. Ayrton), November 10th, 1899.

Prof. Lodge, F.R.S., President in the chair.

Mr. F. S. Spiers read a paper on "Contact Electricity."

The object of the paper was to determine, in a more satisfactory manner than has hitherto been attempted, the part played by the medium in the potential difference which arises when two dissimilar metals are put in contact. The first experiments were made with a piece of apparatus used by Profs. Ayrton and Perry about 20 years ago. This apparatus, in which the metals in contact are capable of a rotation of 180° about a vertical axis, and are placed between two vertical inductors connected to a quadrant electrometer, was afterwards considerably improved, and the compensation arrangement of Lord Kelvin was introduced, so as to measure the potential differences by a null method. The metals first used were platinum and zinc, but on account of the low melting point of the latter metal, it was replaced by aluminium. In order to try and remove the air sheets which cling to the surfaces of the metals, the tube was repeatedly heated and exhausted. The potential difference between the plates was found to gradually fall as this was done. It was proved that this was due to the oxidation of the aluminium, for on cleaning its surface, the original effect was again obtained. Attempts were then made to remove the oxygen by displacing it with hydrogen, but after four washings with pure dry gas, and at low pressures, there was still enough oxygen left to completely oxidise the aluminium. The oxide of aluminium is not decomposed by hydrogen at a bright red heat. It was therefore decided to substitute iron, and burn out the oxygen with hydrogen, by encasing the lower part of the apparatus in a copper tube, and heating to bright redness with a blowpipe flame. By this means the value of the Volta effect between iron and platinum, in an atmosphere of hydrogen, was found to be 0·6 of a volt, the platinum being positive to the iron. This result is different both in magnitude and sign to that obtained when air is the medium.

The Chairman said he had given the subject of contact electricity some attention during the last 15 years, and the author had performed a valuable series of experiments which he should have liked to have seen done several years ago. He had always felt that a vacuum would never get rid of the condensed air films. The burning out process used had provided the most reliable results upon the subject.

Dr. Lehfeldt pointed out that the action of hydrogen upon ferric oxide was a limited one, and that it was impossible to bring about complete deoxidation in that manner. At a dull red heat, the ratio between the water vapour and oxygen present is about 20 to 1.

Prof. Perry expressed his interest in the experiments, but said that they had not affected his opinion upon the nature of the Volta effect.

Prof. Armstrong said he was not wholly satisfied with the results, although a substantial approach to a solution had been made. The author had fully realised the difficulties of the experiments, but he had treated the matter as a surface gas effect, and had not guarded against moisture. Gases must be both dirty and moist before chemical action can take place, and we cannot expect to arrive at a solution of the problem until we have removed not only oxygen but dirt and moisture. It is impossible to completely exhaust the apparatus, and a number of molecules must always be left which is more than necessary to produce the Volta effect. Moisture can never be got rid of by exhaustion. The method of Dewar in using liquid oxygen or liquid hydrogen would get rid of gases and water vapour, and in this manner it would be possible to perform experiments which could be regarded as final. If the effect disappeared at low temperatures it might be urged that the temperature was too low for it to be produced. The author must have been dealing with combination effects, for it had been proved that hydrogen alloyed both with platinum and iron at a dull red heat.

Mr. Cooper said he would like to see the experiments repeated after precautions had been taken to remove nitrogen from the apparatus.

Prof. S. P. Thompson said he had recently taken part in a discussion upon the subject with some earnest followers of the old contact theory. They uphold that the property of metals which determines the potential difference when two are put in contact is as fixed and definite as other physical properties, such as density, and that the potential difference observed in air is approximately the same as the true potential difference. It has been agreed to call the former the apparent potential difference. Prof. Thompson said that the real Volta effect was near to the effect observed in air. In circuits formed of metals, there are other electromotive forces of the order of a millionth of a volt. The chemical electromotive forces in a circuit are of the order of a volt. The value of the Volta effect derived from thermo-dynamical considerations concerning the Peltier effect is much smaller than observed chemical potential differences. If, however, we take into account not only the Peltier effect, but also the Thomson effect, we will have other terms entering into the equations which may tend to give a value more nearly equal to a volt. Prof. Thompson said that, in observing chemical E.M.Fs., the Peltier effects did not come into the question, because of their smallness compared with the value of the chemical effect.

Prof. Perry pointed out that the Peltier effect was not distinct from the Volta effect, but was simply the differential coefficient of it.

The Chairman said that, if a circuit containing Peltier effects were treated thermo-dynamically, as if it were a reversible heat engine, we could arrive at an equation connecting the value of the Peltier effects with the rate of change of the whole electromotive force in the circuit with temperature. The electromotive force which changed was not necessarily the Volta effect.

Prof. Perry said he thought it was.

Prof. Ayrton suggested that advance might be made in the theoretical side of the question if the chairman were to put in writing his objections to the statement that the E.M.F. concerned was the true Volta effect. The extent of the Peltier effect proves the variation of the Volta effect with temperature, but because it is small it does not necessarily follow that the Volta effect is small. Where the Volta effect is a maximum or a minimum the Peltier effect vanishes. The experimental work of the paper didn't go far enough to convince him of the nature of contact electricity. Before we can hope to prove anything with respect to the two theories, we must be able to get a cyclic change of events. That is to say, we must be able to change our surfaces and media in a perfectly definite manner so as to be able at any time to return to the particular state from which we started.

Prof. Everett said that as the variation in the potential difference between two metals in a medium was probably due to slow chemical action which caused the metals to become less and less susceptible, he should expect that changing backwards and forwards from one medium to another would give to the potential difference an oscillatory variation gradually becoming smaller and smaller.

The Chairman said he would like to see experiments showing a cyclic effect similar to that mentioned by Prof. Ayrton. The difficulty in these experiments is to avoid chemical action. Chemical action is not necessary to get the Volta effect. The effect would be greatest in dry gas. Moisture tends to reduce the effect, and that is why its presence is unimportant.

Prof. Callendar expressed his interest in the surface character of the effect and its independence of the manner in which the plates were touched.

Dr. Stansfield suggested gold as a suitable metal to be experimented on because of its non-oxidisability.

Mr. Spiers, in replying, referred to Dr. Lehfeldt's assertion that the whole of the oxygen cannot be removed by hydrogen. In his experiments, however, there was very little ferric oxide and a large quantity of hydrogen, and although it was possible that all the oxide was not reduced, still a large portion of it was. The experiments were to be carried on, and attempts would be made to get a cyclic effect.

A paper on "The Heat of Formation of Alloys" was postponed until the next meeting.

THE ELECTRIC v. THE STEAM TORPEDO BOAT.

When all the world is watching with interest the application of the steam turbine principle to torpedo boats and similar vessels, it is interesting to find someone who will come forward and champion the claims of a vessel which is to be propelled entirely by electrical means. Mr. Charles T. Childs, in a recent issue of the American *Marine Engineering*, has brought forward a bold proposal for utilising electricity for torpedo boats. He approaches the subject from quite a different point of view to that held by naval experts in this country. The naval authorities of Great Britain, in their designs of a torpedo boat, have in view the necessity of making it a sea-going vessel, which can be relied upon to act in conjunction with a fleet, or may be expected to act quite well singly. We believe, also, that the work of a torpedo boat is occasionally diversified by using it as a despatch boat, or fulfilling some of the multifarious duties which occasionally fall to the lot of the smaller vessels of the Navy. But it will be seen how widely different are the opinions of Mr. Childs, when he states that it may be laid down as an axiom, that a boat built for torpedo service has to be so specialised as to be unfit for any other duty. He also adds that the sea-going cruising torpedo boat is a sort of anomalous contrivance, developed out of the struggle for high speed, and is not, properly speaking, a torpedo boat at all. It is hardly necessary, however, to go very deeply into the reasons for and against the use of torpedo boats for various purposes; but it may be observed that the different requirements of various nations can alone decide the type of boat. There is little doubt that Mr. Childs brings some damaging conclusions against the steam-driven torpedo vessel; everyone will admit that one of the essentials of an efficient torpedo boat is that it should be, as nearly as possible, invisible, and no one would seriously doubt that the risk of discovery is much greater if a torpedo boat is emitting smoke; more, the smoke-stack itself will be a more or less conspicuous object. At the same time, we do not think that even a steam-driven torpedo boat will very frequently show flame under forced draught. To quote Mr. Childs's own language: "A steam torpedo attack may be converted into a sort of merry torchlight procession, considerably more dangerous to the attacking party than to the attacked."

No doubt a night attack by torpedo boats is very likely to be discovered by the vagaries that might arise in steam-driven vessels, but we seriously doubt whether the engines that are placed on torpedo

boats are quite so noisy as Mr. Childs would have us believe, though we are quite prepared to admit that a trifling incident would render the attack nugatory. Obviously these criticisms of steam torpedo boats are leading up to a suggestion of some other means of propulsion, and the sum total of Mr. Childs's contention is, that steam should be replaced by accumulators, and he makes out a distinctly good case for the electric boat as against steam. If the torpedo boat can rely upon its accumulators, it ought to prove an efficient aid, especially in repelling attacks; at the same time, the chief objections that arise in one's mind are, that an electric torpedo boat has a limited range of action, and it would be unable to travel far from land, or it must always remain under the convoy of a larger vessel, from which it can obtain its necessary supply of electrical energy; in short, it would lose much of the individualistic action which one associates so highly with torpedo vessels. Apart from these objections, there must be a good deal to render an electric torpedo boat a serviceable craft. It would be distinctly less likely than a steam vessel to give warning of its approach, and it could be, doubtless, operated by a smaller crew than is necessary in a steam vessel. Putting his theory into practical shape, however, Mr. Childs takes the case of a boat 40 feet long, having a beam of 4 feet, and a draught of 5 feet; this will displace, when light, 100 tons, and carry, normally, 30 tons of coal. If 45 tons is allowed for the weight (hull, ammunition, crew, stores, &c), there is left 95 tons, or 213,000 lbs. for electrical equipments. To attain a speed of 22 knots, about 1,500 H.P. will be required. As the torpedo boat goes at full speed only at the instant of attack, the motors installed should be such as to work most economically at lower speeds. They should weigh as little as possible, and should be worked up to their utmost possible output for the rush of attack. Four motors, each developing 400 H.P., could be reduced in weight to 6,500 lbs. each, or 26,000 lbs. for the four; this would leave 187,000 lbs. for battery, circuits, controllers, &c. Allowing 12,000 lbs. for the latter, and 175,000 lbs. for the battery, the question is, says Mr. Childs, what performance could be expected? According to practical tests, based mainly upon the workings of French accumulator vehicles, 175,000 lbs. of accumulators would maintain at the screw 140 H.P. for 24 hours, 300 H.P. for 10 hours, 520 H.P. for 5 hours, and 2,000 H.P. for 1 hour, a power that would give a rush speed of 25 knots. With regard to the crew necessary to operate such a boat, it is assumed that a steam vessel of similar size would carry two officers and 18 men. The electric boat would want enough men to launch the torpedoes and one officer and five men, at the outside. It is assumed by the writer that the cost of such a boat would be about the same as steam, and it is urged that such a vessel would answer all the requirements, and would have sufficient range at low speeds. With an adequate number of circuits and controlling arrangements in different parts of the vessel (both of which arrangements Mr. Childs suggests) there would be obviously some difficulty in disabling a vessel, in the same sense as a well-directed shot would end the career of a vessel propelled by steam. These are conspicuous among many other advantages that would be possessed by an electric torpedo boat, and though one cannot share entirely the enthusiastic views of Mr. Childs, there is no reason to doubt that an electric boat would have a distinct sphere of action; but as we have pointed out, it would rely to a greater extent upon keeping up its lines of communication, either with a vessel or the shore—a course which is not absolutely necessary with a steam vessel. Not for a moment, however, do we suppose that the electric torpedo is likely to supplant the steam-propelled vessel to any considerable extent: it could be nothing more than supplementary. In spite of our desire to see a wider application of electrical machinery, we do not think that Mr. Childs is quite fair to steamboats; because, of the many torpedo boats we have seen, we have been struck with the almost entire absence of noise from the engines, and the absence of smoke, and at night we have been unable to detect, at a few yards distance, the presence of a torpedo boat, save for the swishing of the water. A properly managed steam boat ought to be almost as indistinguishable at operating distance as an electrical one would be.

Moreover, it should not be forgotten that there is a widely accepted theory among naval men that if a torpedo boat managed to plant its torpedo, it would have answered its function, and both officers and crew would accept their extermination as part of the bargain.

THE ARCHBUTT-DEELEY WATER-SOFTENING PROCESS.

We have received from Messrs. Mather & Platt their descriptive pamphlet of the Archbutt-Deeley system of water softening.

The principal constituents of hard water are the carbonates of lime and magnesia, and the sulphate of lime. The latter salt is less easily reduced by heat than is the carbonate, but when it is precipitated, it forms a very hard and tenacious scale, and it can be dealt with by dosing the water with carbonate of soda. The result of the mixture is the formation of carbonate of lime and sulphate of soda. This latter salt is exceedingly soluble, and remains inert in the water, the only danger to be guarded against being the concentration which would occur if a boiler were worked too long without partial blowing out, or entire emptying. The carbonate of lime is insoluble, and will precipitate in the feed tank if a reasonable time be allowed. Bicarbonate of lime is a salt that is not apparently known in the dry state. It probably occurs in solution in water. We say probably, because though it is usual to say that carbonate of lime is only freely soluble in water when there is an excess of carbonic acid gas present, it has been found that the amount of carbonic acid gas is the chemical equivalent of the lime salt, and this is a very powerful argument for the contention that the salt is really bicarbonate. By adding caustic lime or caustic soda to a bicarbonate solution, the extra molecule of carbonic acid is absorbed, and a double amount of insoluble lime carbonate is thrown down by the use of lime. With caustic soda the resulting monocarbonate of soda remains in solution.

It is probable that a lime carbonate water may be softened even by the use of carbonate of soda, for soda is known to exist even dry as a bicarbonate, and possibly it can also exist in solution as bicarbonate. This probably explains why ordinary crystal soda (a hydrated carbonate) will soften a lime carbonate water. But soda is expensive, and carbonate waters, whether containing lime or magnesia, are far more cheaply softened by caustic lime. Moreover, all the lime practically deposits, whereas all the soda remains in solution, and may concentrate to danger point by long evaporation in the boiler.

The caustic lime process of water softening is exceedingly pretty. It is known as Clarke's process, from its inventor, Dr. Clarke, and it is at the base of all water-softening systems. It is sometimes found that when waters have been softened they are very apt to throw down a peculiar deposit in the feed pipes to a boiler. To prevent this, the Archbutt-Deeley process includes a re-carbonating process, by which the softened water is re-impregnated with carbonic acid gas obtained by forcing into it air passed through a small closed coke furnace.

This recarbonates the small excess of alkaline lime remaining in the water and reconverts it to bicarbonate, enabling it to traverse feed pipes without depositing.

There are two tests for softened water. First, if insufficient lime has been added, the addition of nitrate of silver to some of the clear softened water will produce a milky whiteness. If too much lime has been added, there is produced a dark brown discoloration. The correct amount of caustic lime is proved to have been used when a very faint straw yellow colour is produced by the silver solution. If too pale—hardly perceptible—a little more lime is needed, and should be added to the next tank full treated. If too dark, the quantity of lime must be diminished.

Precipitation of the sediment formed by the lime is accelerated if a little of the previously formed deposit is left in the tank and stirred well up with each charge of fresh water. The larger crystals of the old deposit serve as nuclei round which the newly separated molecules of lime carbonate may aggregate. After softening, and when recarbonating is necessary, the sufficiency of the recarbonating is tested by means of a solution of phenol-phthalein. This solution is turned pink by water containing free alkali, but when carbonated sufficiently the water is acid, and the pink colour is no longer formed. The same substance may be used as a test in place of the nitrate of silver. If sufficient lime has been added, a faint pink colour is produced by the phenol-phthalein solution. Too deep a pink indicates, of course, an excess of lime.

It is usual to boil the quicklime in a small tank of water by means of steam. Waters containing organic matter require the addition of a small quantity of alumino ferric to assist precipitation. This coagulates and precipitates albuminoid matter.

It is claimed that by softening water in considerable quantity at once by means of an alternation of large tanks, the results obtained can be made more reliable than by any continuous process. As many as 30,000 gallons of water are treated by the intermittent tank process at the Midland Railway works at Derby. The water comes from the Derwent, which flows for a considerable part of its course through a district of almost pure carbonate of lime, and receives tributaries, such as the Wye and its feeders, which are almost entirely limestone rivers. Of the total area of 300,000 acres drained by the Derwent, 65,000 are limestone areas and 6,000 are limestone shales.

With so many hard waters the process of softening is so cheap and simple that it is very much a matter of surprise that more is not done in this way.

It is estimated that allowing 20 minutes to fill a tank and 20 minutes to empty it into the reserve, with 90 minutes for treatment and settlement, a supply of 1,000 gallons per hour can be softened by means of one tank 8 feet cube if the water can be run into it at the rate of 120 gallons per minute. Similarly for 4,000 gallons per hour a couple of tanks 12 feet square and 10 feet deep will serve with a supply capable of being run in at 360 gallons per minute.

Purely carbonate or temporarily hard water may cost as little as one-fifth of a penny per 1,000 gallons in chemicals, while some of the worst waters, heavily charged with lime sulphate, may cost as much as 4d. But even this is better than paying 8d. per 1,000 gallons for the mains water, which is itself, probably, in need of treatment.

The above estimates of cost are based on a price of 20s. per ton for quicklime, and £4 per ton for 58 per cent. alkali, or alkali which contains 58 per cent. of Na_2O in 100 parts, by weight, this being the trade method of evaluating various forms of alkali manufactured.

"TESTED LAMPS."

Some interesting particulars of the results of tests made by the "Tested Lamp" Company, on the life of various types of incandescent lamp, were recently published in one of our contemporaries. Unfortunately, though not unreasonably, the names of the makers are not stated. One English-made 16-C.P. 200-volt lamp starts at 19 C.P., goes up to 20, then rapidly falls to 9, while the power absorbed rises

from 3·0 to 6·5 watts per C.P. in 432 hours. This lamp is *not* recommended! Another English lamp, which bears a high reputation for long life, is also condemned, the C.P. varying from 12 C.P. to 14, and falling to 9·6, while the power rises from 4·5 to 6·6 watts per C.P. in 336 hours. The best 200-volt lamp tested, also an English one, *fell* rapidly from 20 to 15·8 C.P., at which figure it remained constant for 500 hours; the power varied inversely, from 3·2 to 3·75 watts per C.P. This is a capital result. An American lamp rose from 20 to 21·6 C.P., and gradually fell to 15·6; the power rose from 3·2 to 3·9 watts per C.P. in about 600 hours. Of 100-volt lamps tested, one by the maker of the best lamp mentioned above shows a slight rise to 16·8 and a gradual fall to 13·9 C.P. in 576 hours, with a power consumption of 3·5 to 4·2 watts per C.P. in the same time; a lamp by another maker rose from 17·4 to 18·3 C.P., and fell to 13·5, the power varying from 3·25 to 4·15 watts per C.P. in 600 hours. By integrating the curves it was found that, at 5d. per unit, the American lamp gave 100 C.P. hours for an average cost of 1·7d., while the best English lamp worked out at 1·88d. The two 100-volt lamps gave approximately the same values as the above.

It is interesting to note that in every case the rapid initial change in C.P., whether a rise or a fall, took place during the first 48 hours.

The last lamp mentioned gave on the whole the best electrical results, but was mechanically defective.

THE TUNBRIDGE WELLS OF THE FUTURE.

The residents of this charming inland watering place are in a state of agitation, for is there not a movement on foot to detract from the beauty of the roads by hideous trams on the electric overhead system, to vitiate the pure air of Heaven by nauseous gases emanating from a refuse destructor, and to aid and abet the spread of unparliamentary language by the temper-spoiling adoption of a municipal telephone exchange. Shade of Beau Nash! One can almost imagine that *Arbiter Elegantiarum*, of Tunbridge Wells, writhing in his grave at the very thoughts of the innovations which were proposed on the occasion of Sir William Preece's visit to the electric lighting works, to which we briefly referred in our last issue.

The introduction of "the light of the future" was disturbing enough to the remains of the man who insisted upon early hours, but as for what is to come—well, let the modern reader look back upon the characteristic and interesting life of those who foregathered in the Pantiles in the middle of the eighteenth century, and a sigh of regret will involuntarily escape him at the prosy tale we are about to unfold at the end of the nineteenth.

Badinage apart, it is not long since we had the pleasure of referring to a racy address, given to the Congress of the Sanitary Institute by its president, Sir W. H. Preece, in which he, in the character of a modern Moses, warmly advocated the use of refuse destructors. He dwelt upon them as was appropriate, more from the sanitary than the engineering aspect; but we were pleased to observe that this distinguished engineer is now urging the adoption of a destructor at Tunbridge Wells in combination with an electric light station.

In a place so dependent upon the favour of visitors, and naturally so attractive, it is certainly advisable that no sanitary precaution should be wanting, and we should expect the refuse to be especially rich in cinders, and consequently in steam-raising capacity, in a purely residential district like Tunbridge Wells.

A well-considered scheme should result in considerable fuel economy in the electricity station, while the capital expenditure and the cost of labour per ton of refuse burned, need not be any higher than if the destructor (which may be considered a sanitary necessity) were a separate institution. Some saving may even be effected in the cost of management by putting both installations under one chief.

We do not apprehend that any such egregious mistake is likely to be made as that which has occurred at Shoreditch, where the profits of the undertaking are being swallowed up by a most extravagant arrangement of labour-saving machinery, enormous in first cost, absorbing a very large proportion of the current generated, and so utterly ineffective for its purpose that the cost for labour is considerably higher than that of any other destructor within our knowledge.

The recently published accounts, and the comments thereon in our own columns and those of our contemporaries, will not have escaped notice; but we hope presently to undertake a further analysis of the working costs of this installation, which, as we have pointed out from the commencement, has tended only to the disappointment of those who were erroneously led to expect in the Shoreditch plant something like a revolution in steam raising for the generation of electricity.

In the course of his speech proposing the health of Sir W. H. Preece, Mr. Elvy Robb, the chairman of the Electric Lighting Committee, referred to the municipal electric lighting scheme devised by Sir William some five years ago. Since they had done him the honour to make him chairman of the Lighting Committee it had been the more brought home to him what an important undertaking the ratepayers possessed, and how essential it was in their interest that it should be further developed and not checked. The undertaking, which they began five years ago not without hesitation, could to-day be sold at a very enhanced price if the town contemplated such a foolish step. At Eastbourne the ratepayers allowed a company to do what they ought to have done themselves, and to-day they were buying back the undertaking at a premium, and were paying £80,000 for what was not such a successful undertaking as had cost the ratepayers of Tunbridge Wells only £40,000. He had no doubt a company could be floated on the results of the five years' working in Tunbridge Wells to buy the local undertaking at a profit to the ratepayers of anything between £24,000 and £40,000. Not only had the ratepayers a valuable property, but a handsome return was being made to them. It was therefore a matter for regret that such an undertaking should meet with so much opposition. He gave their opponents every credit for honesty of purpose; he felt additional regret that some of them were gentlemen they were accustomed to regard as among the ablest men on the Council, and he would venture to make that the opportunity to tender the olive branch, in the hope that an end might be put to what had been termed an hereditary feud between gas and electric light. Let them work together in the interests of the ratepayers, instead of in opposition—an opposition which he gave every credit to as being simply intended for honest criticism. Now it had been demonstrated that there was room for both illuminants, and that, moreover, there was really a large demand for the electric light in the town, let them make the electrical supply a still bigger success, because by doing so they must be promoting the welfare of the town. He suggested that now a large sum of the ratepayers' money had been expended, it was too late to discuss the principle of electric lighting, and that all criticism should be solely directed to making the electric lighting a still greater success in the interests of the ratepayers. Their united efforts would be needed to come to a right decision on two questions which were about to occupy the Council, viz., telephony and tramways. He reminded them that the Corporation had no past traditions to go upon. They could only follow the example of other towns which had been successful, and now they found to what extent the burgesses appreciated the great advantages of the electric light, they would with confidence give their attention to other enterprises for the good of the town.

Sir William Preece tendered his hearty congratulations on the remarkable growth and success of their undertaking. He remembered when he first came down there the Council wanted a very small scheme—smaller, in fact, than they really could have—and what had been the result? The growth was so rapid that more than one enlargement was necessary, and in the short space of five years they had 30,000 lamps where only 1,500 were contemplated at the start, and in another year the gross profit alone would repay the original outlay that they were content to start with. Their local undertaking was, however, one of the most remarkable examples of the growth of the electric light, and also of the excellent management of their works. If they looked at the tabulated statements which the technical journals published, they would find that Tunbridge Wells, although not a large town, occupied a position very near the top in the return the ratepayers were making on their capital. The fact that Tunbridge Wells occupied such an unique position was really due to the irrepressible energy and the admirable commercial spirit of their engineer, Mr. Boot, with whose recommendation he was thankful to have had a little to do. Local governing bodies used to be content to make roads, but now they were recognising that tramways were merely advanced forms of roads. As towns grew, and new districts were opened out, it was necessary that a means of reaching the trading or commercial centres of a town without undue loss of time should be provided. Therefore electric tramways, as the best means of transit, were being laid down in every direction. In Tunbridge Wells he believed the housing of the working classes was a prominent question. How did other towns get rid of over-crowded areas? The population was carried out of the crowded centre to the open country and the pure air for themselves and children. Land was cheaper, and cottages and gardens could be provided more cheaply at the end of a tramline. The duty of a town council to improve the public health therefore embraced the application of electricity in this direction. But all classes used tramways, and apart from this, there was the indirect benefit that they made the electrical undertaking profit during the part of the day when their station was being run at a loss. It would also reduce the cost of production, which would put them in a still better position to supply the town, because the working expenses would be covered by a larger return, and their profit would not all have to be made in a few hours of the evening. He urged that the local authority, and not a private company, should construct tramways, especially where they had been wise enough to own the electrical undertaking, because they effected the double object of providing rapid and easy locomotion, and reduced the cost of producing electrical energy at the works. The great desirability of reducing the unprofitable hours of working would also be assisted by a large extension of the street lighting, and he trusted Tunbridge Wells would have the benefit of a large extension in this direction. A third means of reducing the cost of generation was by the provision of a destructor. This was also desirable from the sanitary point of view, as they completely destroyed a danger to health, while providing fuel for the electric light works. The dust destructor had now been brought to great perfection, and they could benefit by the experience of other towns. A destructor should certainly be in connection with their electric light works. Five years ago they questioned him on the point, and he suggested they should wait for the results of other towns' experiments, which they now had. The Town Council, by promoting its electrical undertaking, could at the same time promote the public health as well as effect a great financial economy. He was glad to hear that these questions were going to have their serious consideration. He had much pleasure in proposing continued success to their already very successful electrical undertaking.

Alderman Finch, as one of the oldest members of the Committee, and Mr. Ashby Wood, as the original chairman of the Committee, responded.

Mr. H. L. P. Boot also briefly replied.

The Council on 9th inst. met to consider various matters, among them being a proposal for an application to be made to the Light

Railway Commissioners for an order to construct electric tramways within the borough. Mr. Councillor Robb moved an amendment to this proposition, that the matter be referred to the Lighting Committee, who would have the advantage of Mr. Boot's services, which would enable them to fully discuss the matter. This was ultimately carried.

From the preceding remarks, it will be evident that the Council contemplates moving very shortly in the matter of municipal telephones, but before taking any actual steps, it might be as well for them to peruse an article on the subject on page 1054, of the Electrical Review, for June 30th, 1899.

THE BOARD OF TRADE REPORT ON THE DUBLIN TRAMWAY ACCIDENTS.

The following is a copy of Mr. A. P. Trotter's report to the Railway Department of the Board of Trade:—

8, Richmond Terrace, Whitehall,
October 2nd, 1899.

Sir,—I have the honour to report, for the information of the Board of Trade, that in compliance with the instructions contained in your minute of August 25th, 1899, R. 10,879, I have held an inquiry with reference to certain accidents which have occurred in the working of the electric tramways of the Dublin United Tramways Company.

The inquiry was opened at the Four Courts, Dublin, at 10 a.m., on September 28th, notice having been given to the under secretary, the town clerk, and the secretary of the Dublin United Tramways Company.

Messrs. John Gordon, Q.C., and Mr. J. Fitzgerald Murphy (instructed by Messrs. Casey & Clay) appeared for the Dublin United Tramways Company.

Mr. Henry Bonass, law agent, appeared for the Dublin Corporation. There were also present Mr. Henry Campbell, town clerk, and Mr. Spencer Harty, city engineer.

Mr. Gordon, Q.C., offered on behalf of the tramway company to give every facility for the investigation of the matters, and to produce officers and employés if required.

I stated that the Board of Trade had instructed me to inquire into four accidents which occurred on June 20th, July 30th, July 31st, and August 6th.

Evidence.

Accident of June 20th.

Mr. Towle, resident engineer of the Dublin United Tramways, said that when car No. 5 was going up Grafton Street the trolley left the wire, and the trolley head caught in the span wire. The standard which carried the trolley pole was pulled over, the cast-iron base being broken on the roof of the car. The trolley head was of an old type—part of the original Southern Tramways equipment. He could not tell why the trolley left the wire; this was an accident which often happened. The span wires did not break. The standard did not come bodily from the roof of the car, but the casting was broken, and showed no flaw. A trolley head similar to the one which caused the accident was produced, and the witness explained how it might catch on a wire, either by the screws which projected from it, or by the opening between the trolley wheel and the socket. When it was firmly caught something had to go, and as the wires held the standard was broken. A passenger named Ennis was struck, and received injuries by the trolley pole falling on him.

Mr. Gordon, Q.C., said that these old trolley heads which were mainly the cause of this accident, were now superseded. The new pattern had no projecting parts.

Mr. Towle produced one of the new heads, and explained that it was held to the pole by friction with a wedge and screws. If it became caught it would pull off, and would be prevented from falling by a chain inside the socket. These were being fitted at the rate of about 25 per week. When the new heads were substituted, accidents like the one they were investigating would be practically impossible. Some of the cast-iron bases were broken on the old Dublin Southern Tramways in 1896, but since then this was the only breakage of the kind which had occurred. All the standards were now bolted to the cars right through the roof.

Accident of July 30th.

Mr. Gordon, Q.C., said that this accident occurred in Amiens Street by a passenger pulling a cord. The bridge at which the accident happened was rather low. The wires had been erected in accordance with the wishes of the Corporation, but since the accident span wires had been done away with, and brackets substituted. The city engineer now approved of the reconstruction. The accident was one which the company could hardly avoid. It was almost impossible to prevent a passenger doing something that might be wrong, though he did not think it was wrong. The trolley rope having been pulled, and the trolley having come off, span wires were broken, the trolley wire sagged, and the next car tried to rush through, and broke more of the wires, causing a more alarming state of affairs than existed before.

Persons on the first car who complained of being injured were taken to the hospital, where they remained for some days and were discharged. They were all more frightened than hurt. Any claims that were made were settled by the company. They were all examined by the company's doctor.

Counsel also referred to the obligation to use guard wires, and said that the tramway company were anxious to insulate them. When they came in contact with the trolley wire one or both were burned. The telegraph wires were underground, and most of the telephone wires were going underground. No passengers on the second car were hurt, but bystanders were alarmed at the flashes.

Dr. Chance, questioned as to the nature of the injuries, said that he believed that there were some slight burns, but that on September 1st (the following day) when he examined them they were healed. He thought the injuries were chiefly psychical. One of the persons was a car driver who was not on the tramway at all. He drove some of the other persons to the hospital, and then went back for another fare, and later in the day returned to the hospital, stating that he had received a shock, and asked for compensation.

Mr. Parshall, questioned as to his knowledge of any other instance in which a passenger mistook a trolley rope for a bell rope, said that this was the first time he had heard of it being done. It was unprecedented to the extent of his knowledge. His experience dated from the beginning of the industry of electric traction. Questioned as to what precautions he thought it would be necessary to take to avoid repetition of such an accident, he replied that this was so exceptional that it was hard to say; but that if the trolley were so designed that it would not catch, and if a stop were placed at the base of the trolley arm, it might be prevented. But if it went up only 3 inches, and the head were of a bad design, an accident might happen. The slack of the trolley cord might be taken up, and it might be fastened to a ring at the foot of the trolley pole. Questioned as to the practice of "nursing" the trolley round corners and under points by the conductors, he thought they did as much harm as good, and he would prefer that they should leave them alone.

Mr. Gordon, Q.C., offered to get copies of the depositions taken at the police court inquiry, but was told that these were not needed, the technical part of the matter being very clear.

Mr. Towle said that in this accident the trolley wire was not broken at all; all the "pull off" wires were broken by the second car, and short bracket arms had been put up.

Mr. Parshall said that at a sudden curve it was necessary to have "pull-off" wires, and that they used many "long ears."

Mr. Harty, city engineer, alluded to accidents due to the use of high speeds, but as the question of speed did not enter into the accidents which were the subject of the present inquiry, the matter was dropped.

Accident of July 31st.

Mr. Towle said that the trolley came off at the diagonal crossing piece at the corner of Gardiner Street and Talbot Street. No one was injured. That type of trolley head had been discarded. The trolley head flew up and caught in a guard wire and broke it. This wire came into contact with the trolley wire, and the "short circuit" melted both wires, which fell into the street, causing alarm. The end of the trolley wire which fell was a "short end," that is, it ended at a section insulator, and was therefore "dead" when it fell.

Mr. Parshall, questioned as to the gauge of the guard wire, said that it was, in accordance with the Board of Trade regulations, equivalent to No. 8. Asked whether the guard wires were so thoroughly "earthed" as to "blow" the fuse in the feeder box when the "short circuit" occurred, he replied that no fuses were provided in these boxes. The present system of tramways was divided into 13 sections, and automatic circuit openers at the works were set to open at 300 amperes. He considered that fuses in feeder boxes would "blow" under ordinary working conditions. He thought that half-a-dozen cars might start simultaneously on a half-mile section, and this would "blow" any fuse that could be usefully placed in a feeder box. He admitted that such a coincidence was unlikely, but it is the unlikely which happens.

Accident of August 6th.

Mr. Towle said that in this case one of the new trolley heads caught in a "frog" at College Green, was pulled off the trolley pole, and fell on the conductor, inflicting a slight injury. It had not occurred to them then to use a chain. He thought that this chain would prevent such an accident in future. The stops mentioned by Mr. Parshall to prevent the arm going too high were being put on.

Mr. Gordon, Q.C., said that, owing to the oscillations of the car, it would be difficult to regulate this height, but it certainly would clear the guard wires.

Conclusion.

The four accidents which form the subject of this inquiry were due to the rising of the trolley head above its ordinary position. In two cases (July 30th and 31st) the trolley head wrecked the overhead wires; in one case (June 20th) the overhead wires were so strong, that the cast-iron standard on which the trolley pole is hinged was broken, and in the last (August 6th) the trolley head, intentionally made detachable, came off. In the first and the last of these accidents one person was injured by the fall of parts of the trolley; in the accident of July 30th six passengers compained of injuries from electric shocks, and in the remaining accident no one was injured.

Breaking of Trolley Standard.

It appears that accidents similar to that of June 20th happened somewhat frequently on the old Southern Tramway system. Those standards were merely fastened to the roof by coach screws. That construction was undoubtedly defective, but it has been abandoned and does not affect the present case. The detachable trolley head appears to be well suited to prevent the recurrence of such an accident.

Wires Wrecked by Trolley.

The expression "trolley" is rather indefinite, and includes the pole or arm, the trolley head at the end of this pole, and the wheel which forms part of this head. Trolleys leave or "jump" the trolley wire from many different causes. These causes may be minimised, but

can hardly be removed altogether. It is important, therefore, to prevent such an occurrence from doing injury. So well known is this kind of accident that it is put forward by some tramway engineers as a reason for not using guard wires, but this objection may be at once removed by preventing the trolley head rising more than a short distance above the trolley wire.

The Use of a Stop on the Trolley Pole.

The height of the trolley wire above the rails necessarily varies a little, and the maximum height must be considered, with allowance for "pitching" or oscillation of the car. A limit should then be fixed—in some cases this is 6 inches, and in one town it is said to be 3 inches. The limit, in the case centre running trolleys, as in the ordinary American style, can be easily arranged by putting a spring hook on to the end of the trolley rope, and a ring on the car, doing away with a yard or two of slack, which the conductors at present tie up anyhow.

Having regard to the extraordinary accident of July 30th, when the trolley rope was mistaken for a bell rope, this ring might be fixed on the edge of the canopy over the end platform. In the case of the "Dickinson" or swivel trolley heads, the slack on the trolley rope cannot be used to fix this limit, and an adjustable screw stop may be placed, and is now commonly placed, on the lower end of the trolley pole, as in the "Dawson" pattern.

Where the "Dickinson" system is used to a limited extent, the trolley wire being nowhere more than 5 or perhaps 6 feet from a perpendicular to the centre of the track, the trolley rope may be employed in the ordinary way, but it would be better to secure it to the foot of the trolley pole by a hook and ring. Where the swivel system is employed to a greater extent, with an 8 or 10-foot reach, trolley ropes are likely to cause accidents, and must be secured carefully, or dispensed with altogether, a bamboo with a hook being used instead.

I do not consider that the Tramway Company was to blame, in the first instance, for the accident of July 30th. In the wide experience of Mr. Parshall no similar accident had been heard of. The trolley is generally pressed upwards by powerful springs, with a pressure of about 25 lbs., and in this case, the line being low on account of the bridge, the force applied to the supposed bell-pull must have been between 30 and 40 lbs.

It is much better to use arm construction than span wires where the line is brought down low to go under a bridge, because if the trolley leaves the wire when the wire is low, the blows on the span wires would be much more severe. In such a place guard wires, if any, should be kept at the usual height, to clear the trolley head. This change has been made at Amiens Street.

An Improved Trolley Head.

The difficulty of preventing trolleys from leaving the wire, and the accidents due to this cause, have received attention from tramway engineers, but without much success. Horizontal sliding collectors are used on some tramways instead of trolleys, but that system appears to be more suited for continuous suburban lines than for intricate thoroughfares as those in Dublin.

One of the principal objects of the "Dickinson" trolley system is to enable short bracket arms to be used instead of span wires, and to dispense almost entirely with "pull-off" wires; but, owing to peculiar local conditions, the Tramway Company have been compelled to use both span wires and swivel trolley heads. The pattern of head used until lately, while not more likely to leave the wire than the centre-running trolley, was more likely to catch and to tear down the overhead wires. Mr. Towle has endeavoured to produce a trolley head which, while containing some features calculated to prevent "jumping," aims chiefly at avoiding the damage which the older pattern did to the overhead wires. The novel form and detachability promise to be valuable improvements.

Brackets v. *Span Wires.*

The centre-pole arrangement with brackets on each side for carrying the trolley wire, excellently adapted for tramways in wide streets, is used to a limited extent in Dublin; but it is said to be unsuitable on account of the unsystematic driving of cars, wagons, &c. Some of the brackets used in Dublin are of great length—several exceed 20 feet. Improvements in the swivel trolley head, or greater confidence in its use, should enable much shorter brackets to be employed. It appears that the choice of the bracket or of the span-wire system rests more with the Corporation than with the discretion of the tramway engineers.

Electric Shocks on Tramways.

Without wishing to make light of the effect of electric shocks of 500 volts, or to underrate the importance of securing the confidence as well as the safety of the public, it should be observed that the electrical pressure of 500 volts has been deliberately chosen because the results of shocks due to light or brief contact with a charged wire are not serious. The employés on tramway works often receive them, generally through carelessness.

The injury produced by such a shock may generally be estimated by the resulting burns; shocks due to higher pressures are accompanied by injuries to the nervous system. A passenger on an electric tramway should not be in more danger of receiving an electric shock than a passenger on a railway is in danger of being scalded.

RECOMMENDATIONS.

Guard Wires.

Guard wires are at present a necessary evil. They should be so well connected to earth, by connecting the poles to the rails, that any serious rush of electric current will melt fuses in the feeder boxes. If the traffic on any section is so irregular as to be likely to cause a heavy demand for current, the length of that section should be reduced so that the maximum working current can be carried by a fuse of practical dimensions, and one which will melt in case of a "short circuit." An automatic circuit opener is always placed on each feeder circuit, at the main switchboard at the works. These frequently open when a temporary demand for current largely exceeds the normal current. The switchboard attendant cautiously closes the circuit opener, which sometimes opens again. It would be well if matters could be so arranged that, in the event of a "dead short circuit," after two or three attempts to close the circuit opener, the attendant should be able "blow" a section fuse in a feeder box, by holding up the circuit opener. In the very rare event of a short circuit on a feeder, the circuit opener on the generator would open. The tramway engineers should be allowed free discretion by the Dublin Corporation as to the best mode of "feeding" the half-mile or quarter-mile sections of the trolley wire, and the placing of the switches.

I am not prepared to recommend the general use of wooden strips instead of guard wires. I consider that the adoption of the system of guard wires carried on the telegraph or telephone poles, in common use on the Continent, is very desirable. This has been tried at Blackburn.

I attach more importance to the substitution of this system of guard wires for the present one, than to any other improvement in electric tramways for the safety of the public, but this is a matter which must be arranged between the tramway engineers and the telegraph and telephone authorities, the Board of Trade having no powers in the matter.

The Prevention of these Accidents.

The use of brackets instead of span wires would prevent such accidents as those of June 20th and July 30th.

The use of a stop to prevent the trolley head, after leaving the wire, from touching the guard wires, or the abolition of guard wires of this kind, will prevent such an accident as that of July 31st.

The new form of trolley head will prevent such accidents as those of June 20th and August 6th.

I have the honour to be, Sir,
Your obedient Servant,
ALEXANDER P. TROTTER.

The Assistant Secretary,
Railway Department, Board of Trade.

ELECTRIC MOTORS ON U.S. SHIPS.

THE annual report of Rear-Admiral Melville, engineer-in-chief of the U.S. Navy, deals at considerable length with the question of electrically-driven auxiliaries, and reviews the long discussion on this important subject. Upon the whole, he thinks the opportunities for electric power on ship-board, in spite of its many advantages, are limited by insuperable conditions. The *Electrical World and Engineer* quotes the Admiral's statements as follows:—

"For some time past—in fact, ever since the successful use of electric motors for general power purposes on shore—the Bureau has been carefully investigating their adaptability to the driving of the numerous auxiliary engines on board ship, and in view of the conclusion that the electric drive of the auxiliaries would not, under existing conditions, be so satisfactory and economical, on the whole, as the steam drive, believes it would be of interest to state the reasons for this conclusion.

"This is the more appropriate, because in some quarters the fact that electric motors are extensively used on shore has led to the belief that they would be equally successful on board ship. The Bureau has planned to use electric motors exclusively in its new plant at the Brooklyn Navy Yard, and it will be readily appreciated, therefore, that their non-use on board ship is for very good reasons.

"The advantages claimed for electric motors over small steam engines on board ship may be classed as greater ease of operation, avoidance of heat, which accompanies the use of steam pipes in living places, and much greater economy. Against these, however, are to be put the much greater weight of the necessary electric outfit, the greater delicacy of the type of electric motors ordinarily used, the lack of ready adaptability to the various conditions of service, a general denial of the claims for economy as ordinarily presented, and the increase in the amount of space required below the protective deck for the installation of the necessary dynamo rooms, this space being necessarily taken from coal bunkers.

"On board ship, where excess of weight is so carefully guarded against, it would certainly be very unwise to adopt a change of motive power involving a great increase in weight, unless the advantages gained are very material. It

must always be remembered that, speaking generally, on board ship the use of an electric motor involves a total weight for the motive power at least three times that of the motor itself, because there is always the generator and its driving engine, besides the motors supplied by them; or, in other words, the electric drive of an auxiliary will weigh at least three times as much as the steam drive, assuming the motor to weigh no more than the engine it displaces, although usually it does weigh more. The answer which would be made to this is, of course, very familiar to anybody who has studied the problem, viz., that the auxiliaries are not all in use at one time, and that therefore the generator capacity required is considerably less than the total motor capacity. This is another case where a statement which may be true elsewhere is not true for the circumstances on board ship. Our naval machinery has to be designed so that in time of action everything can be ready for use, and, as a matter of fact, a very little study of the question will show that it not only may, but almost certainly would, happen that every auxiliary on the ship, except the capstan engine and some of the boat winches, would be used simultaneously.

"I wish to emphasise the point that the objection to using electric motors for driving the auxiliaries on board ship is not an objection to the use of electric motors *per se*, but to installing them in a location for which they are not adapted, and where their good features cannot be utilised. What has led to the wide use of electric motors on shore is not only the absence of heat, cleanliness and ease of installation and operation, but above all, the simplicity of the transmission of power from a central station to a distance. Now the great majority of the auxiliaries on board ship are so near the boilers that less piping is involved in a direct steam drive than in an electric drive from dynamos necessarily at some distance from the boilers.

"The ease of transmitting power to a distance over a wire, as compared with great lengths of steam piping, gives the electric drive a very attractive side, even for distances no greater than the maximum ones on board ship, so that we should naturally expect to find electrically-driven capstans and steering engines. These two auxiliaries are not under this Bureau, but are the ones requiring long and objectionable steam pipes through the living spaces. Here, however, another point has been made by some who are very anxious to use motors elsewhere, viz.: That for the service in these cases, motors are not sufficiently reliable. Naturally a system involving four parts, each liable to break down, is more delicate than one involving but two of these parts. With a steam drive there are the boilers and the steam engine driving the auxiliaries. In the electric drive we have the boilers, the steam engines, and also the electric generators and motors. It is merely a detail whether the steam engines operate the auxiliaries directly or whether a smaller number of them, having a greater power in each engine, operate electric dynamos. Personally I should think, however, that if motors are considered sufficiently reliable to drive feed pumps and air pumps on shipboard, for which they are not well adapted, they would be reliable for these other two cases noted, which they fit so well otherwise. The absurdity of an electric drive of auxiliary machinery on board ship situated closer to the main engines than the engines driving the dynamos, becomes all the more apparent when contrasted with the steam drive for auxiliaries situated in the very extreme ends of the ship.

"On the battleship *Alabama* the space required for electric motors, where used, is approximately the same as that required for steam engines to do the same work. The space required for the wiring, &c., is less than that necessary for steam piping, had that been used. The space required for the generating sets is 10,140 cubic feet. The capacity of these generating sets is 256 KW. total. If all the auxiliary machinery on board this ship were operated by electricity, and if the space required for the electric generators were increased in the ratio of the increase of necessary capacity in the generating room, the space that would be required in the generating rooms would be 50,700 cubic feet for a capacity of 1,280 KW. Consequent upon the extension of the use of electricity would be an increase in the total weight of the machinery equal to from 150 to 250 tons as a minimum. This loss in weight is as much as the gain following the use of water-tube boilers. The increased space occupied by the larger generating rooms would accommodate 900 tons of coal, or 3,600 H.P. could be added to the power of the propelling engines, giving the ship, in the first instance, 45 per cent. greater coal endurance, or in the second instance, 1·5 knots increase in speed.

"The operation of electrical machinery is purely mechanical. That this may be done efficiently requires good mechanical ability at the generating engines. Electric difficulties and casualties are almost always questions of mechanical engineering. I know that it would conduce to the efficiency of the service, to the feasibility of a more extended use of electricity, and to an increase in the life of electrical apparatus if the electric generating plant were placed in charge of this Bureau. I therefore recommend that this change be authorised."

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1899.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester and Birmingham, to whom all inquiries should be addressed.

21,614. "Improvements in suspension insulators for the trolley wires of electric tramways and the like." A. Wiseman. Dated October 30th.

21,630. "An electrical appliance for working points to tram and railway lines." G. Chappell, jun., and H. Chappell. Dated October 30th.

21,634. "Improvements in incandescent electric lamps." M. R. Heide. Dated October 30th.

21,637. "Electrodes for arc lamps." H. Bremer. Dated October 30th. (Complete.)

21,640. "Improvements in wireless telegraphy." W. Booth and J. Schuil. Dated October 30th.

21,643. "Improvements in electric cut-outs." J. Peschek and N. Edwards. Dated October 30th.

21,650. "Improvements in systems of control for electrically propelled vehicles and trains." The British Thomson-Houston Company, Limited. (W. B. Potter and F. E. Case, United States.) Dated October 30th. (Complete.)

28,651. "Improvements in electric railways and in controlling devices therefor." The British Thomson-Houston Company, Limited. (W. B. Potter, United States.) Dated October 30th. (Complete.)

21,652. "Improvements in methods of, and means for, synchronising electric motors." The British Thomson-Houston Company, Limited. (F. E. Case, United States.) Dated October 30th. (Complete.)

21,653. "Improvements in regulating electric motors.' The British Thomson-Houston Company, Limited. (F. E. Case, United States.) Dated October 30th. (Complete.)

21,654. "Improvements in electric brakes and methods of operating the same." The British Thomson-Houston Company, Limited. (F. E. Case, United States.) Dated October 30th. (Complete.)

21,655. "Improvements in systems of controlling electric motors." The British Thomson-Houston Company, Limited. (A. S. Garfield, France.) Dated October 30th. (Complete.)

21,656. "Improvements in systems of control for electrically propelled trains." The British Thomson-Houston Company, Limited. (E. A. Sperry, United States.) Dated October 30th. (Complete.)

21,657. "Improvements in electric train control systems." The British Thomson-Houston Company, Limited. (C. E. Barry, United States.) Dated October 30th. (Complete.)

21,658. "Improvements in signal systems for electric railways." The British Thomson-Houston Company, Limited. (S. B. Stewart, United States.) Dated October 30th. (Complete.)

21,659. "Improvements in circuit breakers for alternating electric currents." The British Thomson-Houston Company, Limited. (T. J. Johnstone, United States.) Dated October 30th. (Complete.)

21,660. "Improvements in electric circuit breakers." The British Thomson-Houston Company, Limited. (H. W. Buck, United States.) Dated October 30th. (Complete.)

21,661. "Improvements in circuit breakers or switches of high potential electric circuits." The British Thomson-Houston Company, Limited. (E. M. Hewlett, United States.) Dated October 30th. (Complete.)

21,662. "Improvements in electric arc lamps." The British Thomson-Houston Company, Limited. (G. E. Stevens, United States.) Dated October 30th. (Complete.)

21,663. "Improvements in electric arc lamps." The British Thomson-Houston Company, Limited. (R. Fleming, United States.) Dated October 30th. (Complete.)

21,664. "Improvements in electric arc lamps." The British Thomson-Houston Company, Limited. (C. E. Harthan and G. E. Stevens, United States.) Dated October 30th. (Complete.)

21,665. "Improvements in electric arc lamps." The British Thomson-Houston Company, Limited. (R. Fleming, United States.) Dated October 30th. (Complete.)

21,666. "Improvements in automatic cut-out for rotary electrical converters." The British Thomson-Houston Company, Limited. (C. P. Steinmetz, United States.) Dated October 30th. (Complete.)

21,667. "Improvements in systems of electrical distribution." The British Thomson-Houston Company, Limited. (C. P. Steinmetz, United States.) Dated October 30th. (Complete.)

21,668. "Improvements in alternating electric current system." The British Thomson-Houston Company, Limited. (W. H. Pratt, United States.) Dated October 30th. (Complete.)

21,669. "Improvements in electric meters." The British Thomson-Houston Company, Limited. (E. Thomson, United States.) Dated October 30th. (Complete.)

21,670. "Improvements in alternating electric current transformers." The British Thomson-Houston Company, Limited. (A. R. Everest, United States.) Dated October 30th. (Complete.)

21,681. "Improvements in or relating to electric batteries." A. J. Boult. (E. Perrot, France.) Dated October 30th.

21,720. "Improvements in and relating to switches for electric light." T. Bell and S. Simpson Berry. Dated October 31st.

21,730. "Improved starting and reversing switch for electric motors." J. R. Lockie. Dated October 31st.

21,742. "Improvements in electric railway rail bonds." T. J. McTighe. Dated October 31st. (Date applied for under Patents, &c., Act, 1883, Section 103, May 24th, 1899, being date of application in United States.) (Complete)

21,748. "Improvements in or relating to electric lamps for carriages and like vehicles." T. W. H. Biddle and F. D. Gray. Dated October 31st.

21,778. "Improvements in electrically controlled elevators or lifts." H. Rowntree. Dated October 31st. (Complete.)

21,780. "Improvements in electric relays." H. H. Lake. (W. G. Nixon, United States.) Dated October 31st. (Complete.)

21,785. "Improvements in telephonic repeaters or relays and c rcuits connected therewith and therefor." C. Adams-Randall. Dated October 31st.

21,796. "Improvements in electricity meters." W. M. Mordey and G. C. Fricker. Dated October 31st.

21,807. "Improvements in electric massage instruments." L. Casper and A. H. Pierce. Dated October 31st. (Complete.)

21,810. "Improvements in electrical measuring instruments." H. P. Davis and F. Conrad. (Date applied for under Patents, &c., Act, 1883, Sec. 103, April 1st, being date of application in United States.) Dated October 31st.

21,844. "Improvements in portable telephone apparatus." H. C. L. Holden. Dated November 1st.

21,862. "Improvements in bracket for incandescent electric lamps and the like." R. Bayer. (Colsman & Co., Germany.) Dated November 1st.

21,877. "Improvements in or connected with electric arc lighting." A. Vosmaer. Dated November 1st.

21,881. "Improvements in electric incandescence lamps." H. H. Lake. (La Societe de Commentary-Fourchambault et Decazeville, France.) Dated November 1st.

21,882. "Improvements in means or apparatus for use at the crossing points of electric traction trolley wires." S. S. Grant. Dated November 1st.

21,886. "Improvements in connecting plugs for electrical switchboards." A. T. T. Thomson and P. Warnford-Davis. Dated November 1st. (Complete.)

21,893. "Improvements relating to electric railways." R. Belfield. Dated November 1st.

21,907. "New or improved filaments for incandescence electric lamps and processes for manufacturing such filaments." C. A. Lee. Dated November 2nd.

21,922. "Improvements in and relating to valves for electric action for organs." S. Richardson. Dated November 2nd.

21 960. "Improvements in electric traction." W. A. Burns. Dated November 2nd.

21,966. "Improvements in and relating to the manufacture and repair of incandescent lamps." F. Fanta. Dated November 2nd.

21,968. "Improvements in arc lamps and roller-clutch mechanism for feeding and controlling the electrodes therein." H. H. Leigh. (T. E. Drohan, United States.) Dated November 2nd. (Complete.)

21,990. "Improvements in and connected with cord-grips for electrical apparatus." H. Oppenheimer. (Actiengesellschaft Mix & Genest, Germany.) Dated November 3rd.

22,008. "A new or improved method and means of recording or indicating the amount of electric current or energy in a circuit." F. M. Staunton. Dated November 3rd.

22,016. "Improvements in electrical switches for telephonic systems and other purposes." M. Byng and F. G. Bell. Dated November 3rd. (Complete.)

22,020. "Improvements in or relating to telegraphy without the use of continuous wires." W. P. Thompson. (F. Braun, Germany.) Dated November 3rd.

22,028. "Improvements in or connected with electrodes for electrolysers." R. Eycken, C. Leroy, and R. Moritz. Dated November 3rd. (Date applied for under Patents, &c., Act, Sec. 103, May 3rd, 1899, being date of application in France.) Dated November 3rd. (Complete.)

22,039. "Improvements in means for collecting electricity from the overhead conductors of electric tramways." B. T. Emett. Dated November 3rd.

22,081. "Improvements in and connected with micro-telephones." S. Schiff. Dated November 4th. (Complete.)

22,088. "Improvements in incandescent electric lamps." The British Thomson-Houston Company, Limited. (C. P. Steinmetz, United States.) Dated November 4th. (Complete.)

22,091. "Improvements relating to electric lamps." W. Felsch. Dated November 4th.

22,092. "The electric candle shade adaptor." W. E. Sotheby. Dated November 4th.

22,100. "Improvements in and relating to electric lamps." C. Kellner. Dated November 4th.

22,102. "Improvements in or relating to electric cables." J. Y. Buchanan. Dated November 4th.

23,107. "Improvements in electric alarm water columns." M. L. Bush and C. F. Swain. Dated November 4th. (Date applied for under Patents, &c., Act, 1883, Section 103, April 8th, 1899, being date of application in United States.) (Complete.)

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1898.

3,219. "Improvements in electrical measuring instruments." A. C. Heap. Dated February 8th, 1898. Relates to current and energy meters. An electro-dynamometer for measuring current has fixed and movable coils connected together in series or parallel, and through additional non-inductive resistance with the ends of a main resistance, carrying the continuous or alternating current to be measured. The resistances are made non-inductive, and of material having a low temperature resistance coefficient. The main resistance may be changed, to enable one dynamometer to be used for large or small currents. The current coils of wattmeters may be connected similarly, the pressure coil being connected in series with a high resistance, which may also be changed. The pressure coil of such an instrument may be connected by a switch in two ways, to measure either current or power. 5 c aims.

3,365. "Improvements in telephone systems." D. Sinclair and W. Aitken. Dated February 10th, 1898. Relates to an exchange worked on the central battery system in which the energy of the battery is only operative from the time a subscriber calls to the operator's reply and from the clearing out signal to the disconnection of the plugs. The exchange battery is earthed at its centre, and is connected at one end to the subscriber's indicators and to the clearing-out indicator, the other pole of the battery being connected to the middle point of a differentially-wound relay. The free ends of the indicator are connected to the inner points of the jacks, which are normally contacted by springs; the insertion of a plug breaks this contact. The line springs are shown bridged by a resistance the centre point of which is connected to springs. The subscriber's bell is in a bridge across the lines and the centre point is connected to the armature of electro-magnet. The armature of the electro-magnet is operated by the subscriber in sending a call. The operator's relay is provided with four pairs of contacts of which normally connect the sections of the plugs together. The outer contacts of first and second pairs are connected to a generator and make and break. The outer contact of pair is connected to earth, and the outer contact of the third pair is connected to one coil of the relay. In a modified arrangement, the relay is omitted, the generator being connected to the operator's calling key. The inner contacts and springs are also omitted in the jacks, an electro-magnetic switch being connected to the sockets to make and break the circuit between the resistance and the indicator. The magnet may be operated by a push instead of the telephone lever. In the case of single-board exchanges, the indicator is connected by inner springs across the two line contact-springs. 8 claims.

3,431. "Improvements in anodes for electrolytic operations." H. E. Beach. Dated February 11th, 1898. Anodes, for use in electrolytic operations, are formed somewhat like a fork or comb, that is, with a crossbar from which a number of rods depend or radiate. These rods may also be of any section, but they all taper to a point at the bottom. The provisional specification further states that plate electrodes may be made wedge-shaped, the thick part being at the top. 2 claims.

3,507. "Improvements in electric meters." Evershed & Vignoles, Limited, and S. Evershed. Dated February 11th, 1898. Motor meters having vertical spindles, supported magnetically as described in Specification No. 9,127, 1897, are provided with nearly closed iron circuits for this purpose. These may serve also as brake magnets. The spindle is supported by a permanent or electro-magnet, and is centered by a long pivot working in and on two jewels. The magnet is surrounded by an iron cylinder having a round hole containing an iron disc carried by the spindle. With this arrangement the spindle may be supported clear of the end bearing. In a modification, the disc is larger and extends below or above the perforated disc forming the bottom of the cylinder. In a further modification, the disc has a vertical cylindrical rim situated below a similar cylindrical part on the bottom. In another modification, a cylindrical part on the bottom surrounds the spindle, which carries no additional iron part. The cylinder may be replaced by three or more symmetrically arranged steel rods connected to top and bottom discs. 2 claims.

3,555. "A combined switch and controller for electro-motors." C. P. Eliesen and W. S. Naylor. Dated February 12th, 1898. Switches for controlling electric motors are provided with means (shown in plan) for quickly opening the circuits at any time, and for indicating when the switch arms are making proper contacts. A vertical shaft provided with a handle, has a square part engaging arms, which may be turned over stationary contacts to connect the motor field and armature either in series or parallel with part or the whole of a battery. The shaft is also movable vertically, and carries bars which normally connect contacts in the motor circuit, but can be pushed down to break contact. Turning of the bars is prevented by a fork engaging a guide, The switch arms are connected with a segment, notches in which receive a spring pressed pin when the arms are in proper engagement with the contacts. In any other position the pin is held out by the segment and places a spring in contact with a screw in the circuit of a bell or other indicator. 4 claims.

3,563. "Improvements in or relating to electric arc lamps." F. Brown. Dated February 12th, 1898. Arc lamps are provided with airtight casings and globes, for use in air containing combustible gas or dust, and with cut-outs arranged to disconnect the lamps if the globes are broken so that enclosed liquid or compressed gas escapes. In one arrangement, air is compressed into the casing and globe through a non-return valve, and raises a piston against a contact spring by which the lamp circuit is completed. In a modification, two concentric globes are used, and air is compressed through a valve into the space between them, which communicates with a cylinder containing a piston operating a switch-lever. In another arrangement, a liquid is circulated through pipes and between two concentric globes, the inner of which floats in the liquid and carries metal pieces to close the circuit through pieces fixed on the lamp casing; the inner globe is kept in position by guides. 5 claims.

3,806. "Improvements in apparatus for making and breaking electric circuits at predetermined times." H. O. Swoboda. Dated February 15th, 1894. Relates to switches for making and breaking the circuit at pre-determined times. Two adjustable contact arms are mounted on a spindle driven by a clockwork or other suitable motor. They engage with spring contacts and send a momentary current through one or other of the electro-magnets, the armatures of which are carried by a swinging pivoted frame. A weighted extension of the frame passes through a slot in the cross-piece of the double-pole switch and throws it into or out of contact with the spring, according to which of the magnets is energised. In order that the contact with the springs may be only momentary, the arms are fitted with insulating pieces. 4 claims.

3,850. "Improvements in holders for electric glow lamps." W. Geipel, F. M. T. Lange, and W. R. R. Saltrick. Dated February 16th, 1898. Relates to ho ders for incandescent lamps. A cylindrical insulator is made with too deep cavities to receive plunger carriers. Each plunger carrier is constructed with an inclined hole, into which the supply wire is passed through a tapered hole in the insulator. The wire is secured by a screw, placed so as to be accessible over the edge of the insulator, which may be recessed for the purpose, if necessary. The tapering of the hole permits the end of the insulating covering on the wire to be placed within it. 3 claims.

4,455. "Improvements in or connected with electric railways of the sectional conductor type." F. C. Esmond. Dated February 22nd, 1898. Relates to electric railways and tramways on a road contact or sectional conductor system with electro-magnetic switches provided with leakage arrangements. The switches are excited by a shunt current from the studs through the fine wire coil to earth or return, thereby lifting the armature which completes the circuit from the main conductor to the stud through a holding-up coil and a coil. The latter breaks the earth connection for the shunt circuit. To ensure the release of the switch when the vehicle passes from over it, a leakage plate surrounds, but is insulated from, the stud and is connected to a coil on the switch magnet wound so as to oppose the effect of the other coils. This plate may be touched by an additional brush on the collector. The exciting and holding up coils surround a common movable core which is thereby lifted into contact with the exposed stud and the contacts connected to the main. These contacts and the magnets are separated by an insulating partition in the switch box. The cap or a projection on it is sufficiently magnetised when the current pa ses through the holding up coil to lift an armature which breaks the shunt circuit. To supply current for the switches, if the main supply fails, a motor generator on the vehicle, worked by the line current, charges a storage battery and this works the generator to supply a local current when required. 5 claims.

4,549. "Apparatus for electrically controlling the hoisting mechanism of elevators or other type of machinery." H. H. Leigh. (F. J. Sprague, United States.) Dated February 23rd, 1898. Relates to an electrical system for controlling and regulating a lift or other motor directly from a switch in the cage. The following objects are effected:—The motor, which is shunt wound, having been started, an intermediate speed is obtained by cutting out resistances in the armature circuit simultaneously with an increase of the resistance in a shunt circuit of the armature which is ultimately opened. Full speed can then be obtained by decreasng the field strength of the motor. A too rapid change in the strength of the current in the main motor is prevented by the introduction of a throttle which acts preferably by regulating the strength of a current passing to a pilot motor employed to automatically operate the controlling apparatus. The main motor is also fitted with an electric brake, which, whilst the motor is slowing down after the circuit has been opened, is held off by a current generated by the motor itself. A diagram is given showing the arrangement of the circuits in the case of the application of the system to a shunt-wound motor, the arrangement being such that the current can be sent through the armature in either direction, while the current through the field magnets passes in one direction only. The controlling apparatus is operated by a pilot motor, the circuit of which is automatically interrupted as soon as the controlling apparatus has been brought into a predetermined position. Upon the opening of the circuit at the cage switch or elsewhere, or upon failure of the current, the controlling apparatus is returned automatically to its initial position independently of the position of the operator's switch. The hoisting machinery forming the subject matter of Specification No. 30,923, A.D. 1897, is described but not claimed in the present specificadon. 5 claims.